All Rights Reserved.] Telegraphic Address: "Ageekay, London." A B C Code. [Registered at G.P.O. as a Newspaper.

VOL. XXVII.]
No. 664.] AUGUST 15, 1890. [PRICE FOURPENCE.

AUG 26 1890

THE ELECTRICAL REVIEW

LONDON: PUBLISHING OFFICE, 22, PATERNOSTER ROW, E.C.—SUBSCRIPTION per annum, Postage inclusive, in Great Britain, 19s. 6d.; to Countries in Postal Union, of the first class, 21s. 8d.; of the second class (Aden, India, Persia, &c.), 23s. 10d.—NEW YORK: D. VAN NOSTRAND, 23, Murray Street, and 27, Warren Street. PARIS: Madame VEUVE J. BOYVEAU, Librairie Etrangère, 22, Rue de la Banque. BERLIN: A. ASHER & Co., 5, Unter den Linden.

FOR CONTINUOUS OR ALTERNATING CURRENTS.

BROCKIE-PELL ARC LAMP
ABSOLUTELY STEADY AND RELIABLE.

BROCKIE-PELL ARC LAMP
IN SERIES OR PARALLEL.

BROCKIE-PELL ARC LAMP
OUTDOORS OR INDOORS.

BROCKIE-PELL ARC LAMP
SINGLE CARBON DOUBLE CARBON.

BROCKIE-PELL ARC LAMP
16 HOURS 32 HOURS.

BROCKIE-PELL ARC LAMP
EXTREMELY SIMPLE. GIVES NO TROUBLE

BROCKIE-PELL ARC LAMP

NEW ILLUSTRATED CATALOGUE NOW READY.

Sole Makers:

JOHNSON & PHILLIPS,
ENGINEERS AND ELECTRICIANS
14, UNION COURT, OLD BROAD STREET, LONDON, E.C.
Works and Wharf: CHARLTON, KENT.

TELEPHONE No. 1010. Telegrams: "JUNO, LONDON." A B C CODE, 4th Edition. 113

SILVER MEDAL, INTERNATIONAL ELECTRIC EXHIBITION, 1882.

International Inventions Exhibition, 1885, GOLD MEDAL for Machinery, SILVER MEDAL for Cables and Wire.

MANUFACTURERS
(By Patent Processes)
OF
Silk and Cotton Covered Wire and Tape of all Sizes for Electrical purposes.

Specially Insulated Electric Light Leads, Cables and Multiple Wire for the various Systems.

WALTER T. GLOVER & Co
ELECTRIC LIGHTING

MANUFACTURERS
(By Patent Processes)
OF
Fancy Silk Covered and Flexible Wires for Lamp Suspending, &c.

Double Concentric Electric Light Cables for Ship Work.

All classes of Aërial and Underground Cables to any Specification.

Special Anti-Induction Cables for the Telephone.

Contractors to H.M. Postmaster-General the Indian Government, the principal Railway, Telephone, and Electric Light Companies.

MANUFACTURERS, BY PATENT PROCESSES, OF GLOVER'S PATENT COVERED IRON WIRE FOR AËRIAL LINES.

Glover's Patent Covered High-Conductivity Copper Wire for Aërial Lines.

Glover's Patent Covered Gutta-Percha Wire for Leading-in, Tunnel, and Underground Work.

THOROUGHLY INSULATED ANTI-INDUCTION TELEPHONE CABLES UP TO ONE HUNDRED WIRES.

WALTER T. GLOVER & CO.,

Electrical Wire and Cable Makers,

TELEGRAM ADDRESSES:
"WALTER GLOVER," SALFORD.
"PHONOSCOPE" LONDON.

SALFORD, MANCHESTER.

ESTABLISHED 1868.

WORKS:—
Bridgewater Street Iron Works.
Salford Electric Wire Works.
Springfield Lane Cable Works.
SALFORD.

LONDON: 10, HATTON GARDEN, E.C. 1847

ELLIOTT BROTHERS,

101 & 102, ST. MARTIN'S LANE, LONDON, W.C.

(ESTABLISHED 1800).

ELECTRICAL ENGINEERS AND MANUFACTURERS OF ALL KINDS OF ELECTRICAL TESTING AND TELEGRAPH INSTRUMENTS.

SUBMARINE MINING APPARATUS, &c. CONTRACTORS TO H.M. GOVERNMENT.

Sole Agents in England for Sir William Thomson's Standard Electric Instruments.

Highest Award Paris Exhibition 1889. Only "Grand Prix" to any English Electrical Exhibit.

Telegraph Address: "OHM," LONDON. Telephone No. 3852. 3169

TUBULAR POSTS OR POLES

TUBES

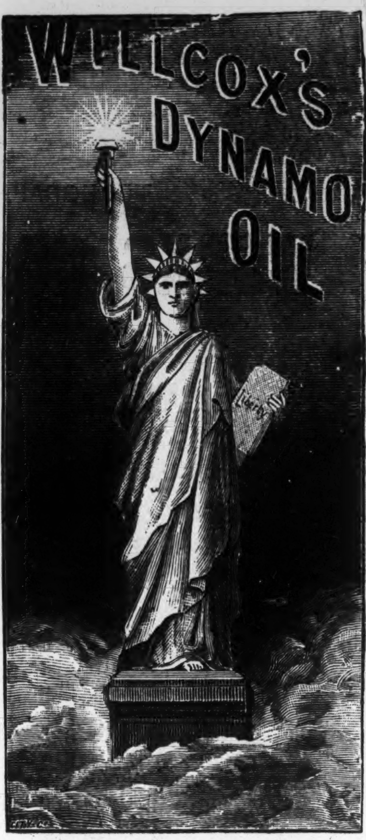
for "ELECTRICAL CONDUCTORS."

WROT IRON OR STEEL.
GAS, STEAM, WATER, BOILER TUBES AND FITTINGS.
PLAIN OR GALVANIZED

JOSEPH AIRD,

TUBE-WORKS. GREAT-BRIDGE, STAFFORDSHIRE.

LONDON OFFICE: 46, QUEEN VICTORIA ST E.C.



W. H. WILLCOX & Co.,
Oil Refiners,
36, SOUTHWARK STREET,
LONDON.
Works:—EWER STREET,
TELEPHONE No. 3740.

ONLY OIL used last three years by the largest Electric Installations in London. Samples sent on application.

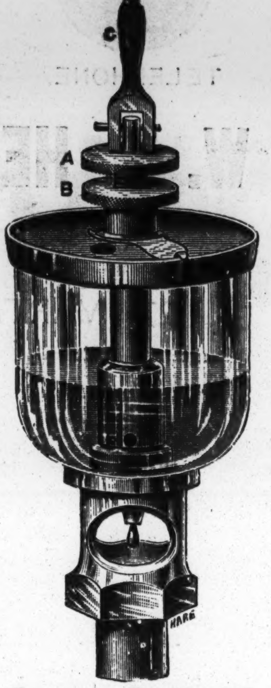
SUCCESS GUARANTEED. TRIAL SOLICITED.

Price 2s. 9d. per Gallon.

Our Oil is now recommended by the principal Electricians, and is also suitable for

SHAFTING, ENGINES,
AND GENERAL PURPOSES. 2927

PATENT
OIL CUP
With Visible Drop Feed.



For use on Dynamos and High-Speed Engines.

THE UNITED ASBESTOS Co., LIMITED.

DOCK HOUSE, BILLITER ST., LONDON, E.C.
(*Late 161, Queen Victoria Street.*)

PIONEERS OF THE ASBESTOS TRADE.

ITALIAN ASBESTOS Co. LIMD. LONDON. PURE ITALIAN MILLBOARD EXTRA QUALITY A1 UNITED ASBESTOS. IS THE BEST.

The ONLY COMPANY in the World owning and working Asbestos Mines in both ITALY and CANADA. 3647

FINE ASBESTOS PAPER, for Dynamos, &c.
ASBESTOS TUBES & CEMENT, for Electric Light Leads.
ASBESTOS FIRE-PROOF PAINT, for protecting wood-work, troughs for leads, &c.
ASBESTOS MILLBOARD STRIPS, for ditto.
FINE ASBESTOS THREAD, for covering wires.
ASBESTOS COVERED WIRES.
PATENT SALAMANDER LUBRICANT, for Dynamos, &c.
PACKING, NON-CONDUCTING COVERING for Boilers, &c.

All Goods are made at our Works, near London, and are of the best possible description.

Specify "**SALAMANDER**" Brand.

Depôts: NEWCASTLE-ON-TYNE, Quay Side; MANCHESTER, 34, Deansgate; LIVERPOOL, 47 and 49, South John Street; GLASGOW, 60, West Howard Street; CARDIFF, Mount Stuart Square; BRISTOL, Provident Buildings, Clare Street; ST. PETERSBURG, Gostinoe Dvor.

FREDERICK SMITH & CO.,
CALEDONIA WORKS, HALIFAX.
Contractors to Her Majesty's Government & Railway Companies
BEST REFINED TELEPHONE WIRE.
PATENT GALVANISED TELEGRAPH WIRE.
100 lb. COILS. HIGH CONDUCTIVITY.
SPECIALITY:—TELEGRAPH WIRE, TO ALL SPECIFICATIONS.

COPPER WIRE, hard drawn, high conductivity—long lengths. COPPER WIRE and TAPE for Lightning Conductors, &c. COPPER WIRE, all sizes for covering. STRAND WIRE all kinds. GALVANISED HARD STEEL STRAND for Mechanical Telephones. 1854

F. WIGGINS & SONS, 10, TOWER HILL, E., and 102, MINORIES, E.C. **LONDON,**
MICA MERCHANTS, [*Telephone No.* 2248.
Manufacturers of Mica Goods for Philosophical and ALL purposes.
CONTRACTORS TO HER MAJESTY'S GOVERNMENT. 2821

MICA.

H. GARDNER
PATENT AGENT.
166
FLEET STREET
E.C.
IN PASSAGE
PATENT OFFICE
PATENT OFFICE INVENTIONS PROTECTED BY ROYAL LETTERS PATENT H. GARDNER

NEW AND CHEAP PATENT LAW.

PATENT OFFICE.
H. GARDNER,
166, FLEET STREET.
LONDON.
SUCCESSOR TO
Messrs. Robertson, Brooman & Co.

Pamphlet of Costs Gratis.

Thirty-five Years' special practice with Inventions.

Provisional Protection (9 months) £4 4s. Full Patent (4 years) £16 16s. 3184

Wm. M. FOXCROFT
(*Successor to the late W. Foxcroft, also F. Lucas*),
Telegraph and Telephone Case Manufacturer,
36, PERCIVAL STREET AND 9, SMITH STREET,
CLERKENWELL, LONDON, E.C.
(Offices—PERCIVAL STREET).

Lock and Block, Single Needle, Bell, Sounder, Perforator, Photometer, Telephone Cases, Battery Boxes, &c., &c.

PRIZE MEDALS, LONDON, 1851; PARIS, 1881. 301

TELEPHONE No. 1734.

Telegraphic Address:
"HENLEY'S WORKS," LONDON.

TELEPHONE.

TELEGRAPH.

W. T. HENLEY'S TELEGRAPH WORKS CO.,

LIMITED,

27, MARTIN'S LANE, CANNON STREET, LONDON, E.C.

HENLEY'S

UNDERGROUND

HIGH TENSION.

LOW TENSION.

UNDERWATER

CABLES

FOR BOARD OF TRADE RULES

AND

FIRE OFFICE REGULATIONS.

WORKS:

NORTH WOOLWICH.

ELECTRIC LIGHT.

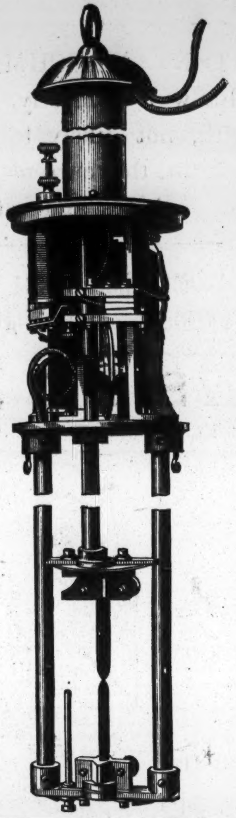
TORPEDO.

THE PLANET ELECTRICAL ENGINEERING Co., LTD.
4, VICTORIA MANSIONS, WESTMINSTER.

PLANET ARC LAMP

The only Reliable Motor Lamp in the market for Street Lighting, Ships and interior of premises.

Positive Feed. Can be burnt in any position. All Engineers connected with Central Stations should see this Lamp.



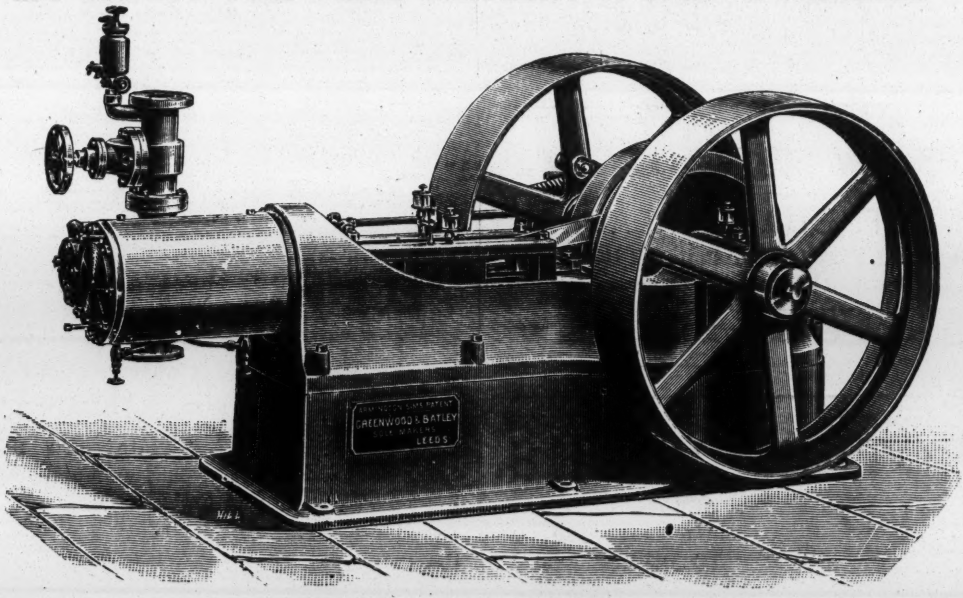
FOR DIRECT OR ALTERNATING CURRENTS.

Prof. SILVANUS THOMPSON says:—"This is the Electrical Engineer's Lamp."

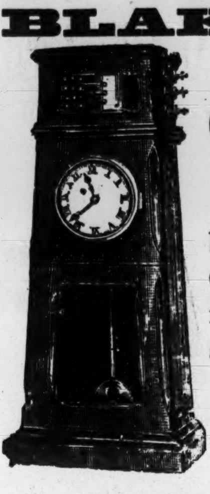
ARMINGTON-SIMS PATENT ENGINE,
SPECIALLY ADAPTED FOR
ELECTRIC LIGHT INSTALLATIONS
AND FOR ANY WORK WHERE UNIFORMITY OF SPEED IS DESIRABLE.

GOLD MEDALS:
EDINBURGH, 1886; LIVERPOOL, 1886.

GOLD MEDAL
Awarded at the International Inventions Exhibition
South Kensington, 1885.



SOLE MAKERS:
GREENWOOD & BATLEY, LTD., ALBION WORKS, LEEDS.
PRICES ON APPLICATION.
1706



BLAKEY, EMMOTT & CO.,
LIMITED,
NORTHERN TELEGRAPH WORKS, HALIFAX, ENGLAND,
CONTRACTORS TO THE BRITISH, INDIAN & COLONIAL GOVERNMENTS.

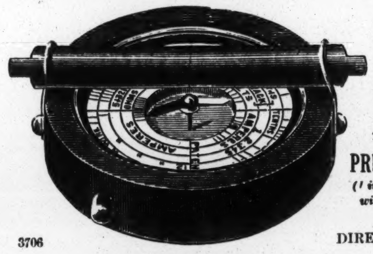
FLETCHER'S PATENT WATCHMAN'S TELL-TALE—Largely used by the L. & N. W. Railway Company, the Government of Victoria, &c. Cannot be tampered with, not likely to get out of order, only one wire required for the whole circuit, the current only used once during the round, and the first cost is low. Prices and estimates on application.

RESISTANCE COILS, GALVANOMETERS, SINGLE NEEDLE INSTRUMENTS, REPEATERS.
LECLANCHE BATTERIES. ILLUSTRATED LIST, FOUR STAMPS. 521

J. D. F. ANDREWS & Co.,
41 & 42, PARLIAMENT STREET, LONDON, S.W.

Complete System of Concentric Wiring for Interiors Andrews's Patent Joints, Switches, Fuses and Fittings. Lists and Trade Terms on application.

MOSELEY'S
PATENT
POCKET ELECTROMETER.



A Perfect Ammeter (from 1-10th to 1,000 amperes), Wireman's Detector and Pole Indicator, as well as a thoroughly practical Volt and Ohmmeter, &c.—See "Electrician," March 14th, 1890.

PRICE, Post Free, 2s. 9d
(Divided to 5 amps., 5 volts, and 5 ohms, with a 5-standard ohm resistance coil)

3706

DIRECT FROM THE MAKER,
W. MOSELEY, 82, Montpelier Rd., Peckham, London

ARTHUR B. GILL & Co.,
Electric Light and General Engineers,
4, BOMBAY STREET, BERMONDSEY, LONDON, S.E.

Sole Makers of GILL'S PATENT MAIN SWITCHES, which are practically everlasting. No sparking on the actual contact pieces. These switches improve with using. Makers of the "GILL" DYNAMO AND MOTOR, which are unequalled for cheapness and efficiency. SUPPLIERS OF ALL ELECTRICAL REQUISITES. LIBERAL TRADE TERMS.

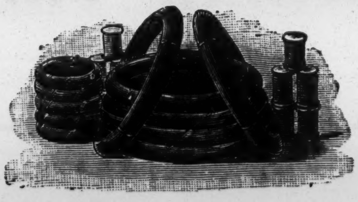
Telephone No. 4832. *Telegraphic Address: "TORQUE."* 2949

CARBONS.
H. & F. CHAMBERLAIN,
Manufacturers of Pure Carbon Points, Tubes, Filters, Cells and Battery Plates of every description.

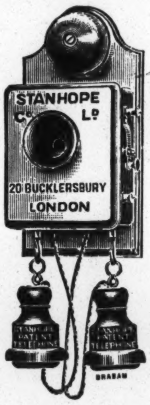
WORKS:—BARNSLEY.
Telegraphic Address:—"CARBON BARNSLEY." 3398

ELECTRIC WIRES.

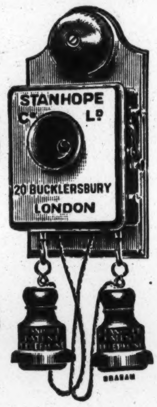
Insulated Wire and Cables of every description for Electrical Instruments, Dynamo Machines, Electric Bells, Telephones, Electric Lighting, &c., &c.



UNITED ELECTRIC WIRE Co.,
14a, Clerkenwell Green, London, E.C. 1730



STANHOPE
TELEPHONES
GUARANTEED.
£1 10s. to £6
PER INSTRUMENT.
3269

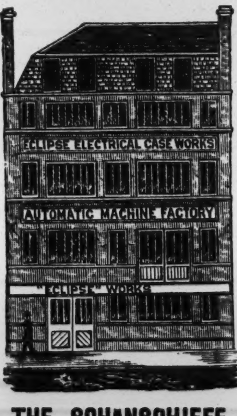


THOMAS BARRACLOUGH & CO., Ltd.,
Makers of all the most Improved Machinery for Electric Wire and Strand Covering, Lapping, Taping, Braiding, &c.,
ALSO FOR
STRANDING AND MAKING CABLES OF EVERY SIZE AND DESCRIPTION.
Globe Works, Rochdale Road, Manchester. 1960

H. THORPE,
MAKER OF EVERY CLASS OF
Screw, Terminal and Turned Parts,
Also any Description of
ELECTRICAL OR MECHANICAL AUTOMATIC MACHINES.
SOLE MANUFACTURER OF THE ENGLISH REMINGTON TYPE WRITER.
All High-Class Machine Work, Turning, Boring, Screw Cutting, &c.
Wheels Cut to 12-inch die in Iron, Steel, or Brass.

OPEN TO TAKE AGENCY FOR ANY MECHANICAL OR ELECTRIC MAGHINE.
Works: 34, Eagle St., Red Lion Square.

"ECLIPSE" ELECTRICAL



CASE WORKS,
5, PHŒNIX PLACE,
COLDBATH FIELDS, LONDON, W.C.,
MANUFACTURERS OF
Every description of Cases
BY MACHINERY
FOR
TELEGRAPH, TELEPHONE, AUTOMATIC
And Electrical Instrument Makers.

MAKERS OF 2968
THE SCHANSCHIEFF PORTABLE BATTERY CASES.

FACTS!!

The Crompton-Howell Electrical Storage
Co., Ltd., have erected, or are erecting,

THE

CENTRAL STATION BATTERY,

in connection with Central Stations,
supplying

300,000 LAMPS.

These Batteries act as a reserve for the
above, or will run

50,000 LAMPS

direct without machinery.

QUOTATIONS FREE.

THE
CROMPTON-HOWELL ELECTRICAL STORAGE
COMPANY, LIMITED.
MANSION HOUSE BUILDINGS, LONDON, E.C.,
AND
Works:—NEW DOCK, LLANELLY.

Telegraphic Address: "POROSITY," LONDON. Telephone 1,663.

3911

BEST WIRE
FOR
OVERHEAD TELEPHONE & TELEGRAPH LINES,
And all Electrical Purposes.

SILICIUM BRONZE.

PHOSPHOR BRONZE
CASTINGS,
&c.

Patent
Phosphor Bronze
for Springs, Ropes, Screws,
Rods, Sheets, &c., Bearings, Bushes,
and other wearing parts
of Machinery

Patent Silicium
Bronze and Silicium Copper
Wire of Great Tensile Strength
and High Conductivity for Telephone
and Telegraph Lines & other
Electrical purposes.

PHOSPHOR BRONZE
VULCAN
PHOSPHOR
DURO METAL

PHOSPHOR BRONZE.

SOLE PROPRIETORS
Of the British and Colonial Patents,
THE PHOSPHOR BRONZE CO.,
LIMITED,
87, Sumner Street, Southwark, London, S.E.

BEWARE OF SPURIOUS IMITATIONS, FALSE REPRESENTATIONS. AND INFRINGEMENTS OF OUR PATENT RIGHTS.

GREEN'S

FUEL ECONOMISER

APPLIED TO STEAM BOILERS.

E. GREEN & SON, Ltd.,
14, ST. ANN'S SQUARE,
MANCHESTER.

3337

DORMAN & SMITH,
ELECTRICAL ENGINEERS,
Manufacturers to
all the principal Contractors.

BRAZENOSE ST.,
MANCHESTER,
England.

INDEX TO ADVERTISEMENTS.

The names of Advertisers, whose announcements are ordered for a series, are entered under any one Heading in this Index free of charge but if repeated under other headings, 6d. per week is charged for each additional entry.

PAGE
Accumulators.
Crompton-Howell Elec. Storage Co. 7
Drake & Gorham ... ...
J. Stiff & Sons (Boxes only) ...
Arc Lamps.
J. H. Holmes & Co. ... ... *Sup.* 11
Johnson & Phillips 1
Planet Elec. Engineering Co. ... 5
J. & W. Roper 12
Simplex ... ... *Sup.* 8
Statter & Co. 15
Asbestos.—Bell's Asbestos Co. 16, 17
United Asbestos Co. 3
Auctioneers and Valuers (Mechanical).
Wheatley Kirk, Price & Goulty *Sup.* 11
Batteries.
India-rubber, G.P. & Tel. Wks. Co. 20
Johnson & Phillips 1
Telegraph Mfg. Co. ... *Sup.* 2
Battery Jars.—J. Bourne & Son ... 13
Price, Sons & Co., ...
J. Stiff & Sons ... ...
Bells.
Genl. Elec. Co., Ld. (G. Binswanger.) *Sup.* 10
Sheppard, Allarton & Madeley ...
Belting.—Webb & Son 12
Boilers.—Babcock & Wilcox Co. *Sup.* 6
Ewen & Co. ... ... *Sup.* 16
Books.
Berly's Electrical Directory *Sup.* 14
G. W. & Elec. Ltg. Co. Directory *Sup.* 14
Cabinet Work.—Eclipse Works ... 6
W. M. Foxcroft 3
Castings.—J & J. Hughes 12
Phosphor Bronze Co. 8
Chemicals.
Boor & Co. 15
Dynamos.—Andrews & Preece *Sup.* 7
H. Austin ... ... *Sup.* 7
Bolling & Lowe ... ... *Sup.* 6
Gülcher Electric Light & P. Co. 13
J. H. Holmes & Co. ... *Sup.* 11
Johnson & Phillips 1
Laurence, Scott & Co. ... ...
C. Oppermann 12
C. A. Parsons & Co. ... ...
J. & W. Roper 12
Stanley & Davies ... ...
J. G. Statter & Co. 15
Ebonite.
Harburg India Rubber Comb Co. *Sup.* 11
D. Moseley & Sons... ... ...
North British Rubber Co. ... 13
Electrical Engineers and Contractors.
Acme Electric Works ... *Sup.* 1
J. D. F. Andrews & Co. 6
Andrews & Preece ... ... *Sup.* 7
Appleton, Burbey & Williamson *Sup.* 18
Blakey, Emmott & Co., Ltd. ... 6
R. Bolton & Co. 12
Callender's Bitumen Tel. &c. Co. ... 11
Charlesworth, Hall & Co. ... *Sup.* 16
Crompton & Co. ... ... *Sup.* 20
Drake & Gorham ... ...
Electrical Eng. Corporation ...
Elliott Bros. 2
General Elec. P. & Traction Co. ...
W. T. Goolden & Co. ... *Sup.* 13
India-rubber & Telegraph Works Co. 20
Johnson & Phillips 1
Laing, Wharton & Down... *Sup.* 4
Laurence, Scott & Co. ... ...
Paterson & Cooper 19
Rashleigh Phipps & Dawson ... 10
C. A. Parsons & Co. ... ...
Poole & White ... ... *Sup.* 17
Electrical Engineers, &c.—*Cont.* PAGE
Reid Bros. 11
Ernest Scott & Co. 15
Ronald A. Scott ... ... *Sup.* 5
Sharp & Kent ... ... *Sup.* 13
M. Holroyd Smith ... ... *Sup.* 9
Swinburne & Co. ... ...
Telegraph Mfg. Co. ... *Sup.* 2
Western Electric Company *Sup.* 20
Westinghouse Electric Co. *Sup.* 20
Woodhouse & Rawson United ... 11
Electric Light.
Brush Electrical Engineering Co. 10
Bernstein Electric Lamp Co. ... 12
India-Rubber, G. P. & Tel. Wks. Co. *Sup.* 1
Johnson & Phillips 1
Laurence, Scott & Co. 19
Thomson-Houston ... ... *Sup.* 4
Electric Light Carbons.
H. & F. Chamberlain 6
Genl. Elec. Co., Ld. (G. Binswanger.) *Sup.* 10
Johnson & Phillips 1
Lacombe & Co. ... ...
Woodhouse & Rawson United ... 11
Electric Light Fittings.
Dorman & Smith 9
Electrical Accessories Co.... ...
Faraday & Son 10
Genl. Elec. Co., Ld. (G. Binswanger.) *Sup.* 10
Rashleigh Phipps & Dawson ... 10
B. Verity & Sons 12
Walsall Electrical Co. ... ...
Engines for Electric Light.
W. H. Bailey & Co. 14
Browett, Lindley & Co. ... *Sup.* 3
Davey, Paxman & Co. 10
Greenwood and Batley 5
Marshall, Sons & Co. 15
John Musgrave & Sons ... *Sup.* 2
Priestman's Oil Engine ... ...
Ransomes, Sims & Jefferies ...
Robey & Co. 14
Stockport Gas Engine ... ...
Willans & Robinson ... *Sup.* 19
Engraving.—Gilkes ... ... *Sup.* 11
Fibre.—David Moseley & Sons ...
Fire Insurance.
Phœnix Fire Office ... *Sup.* 12
Fuel Economisers.
E. Green & Son 8
Glass Manufacturers.
Genl. Elec. Co., Ld. (G. Binswanger.) *Sup.* 10
Incandescence Lamps.
Brush Electrical Engineering Co. 10
Sunbeam Lamp Co. ... *Sup.* 3
Woodhouse & Rawson United ... 11
India-Rubber.
India Rubber, G. P. & Tel. Wks. Co. 20
D. Moseley & Sons ... ...
Insulators, &c.—Bourne & Son ... 13
Price, Sons & Co. ... ...
Stiff & Sons ... ...
Telegraph Mfg. Co. ... *Sup.* 2
Lubricants.
W. H. Willcox & Co. 3
Manufacturing Electricians.
A. Apps ... ...
Cox-Walkers 13
Dorman & Smith 9
Elliott Bros. 2
Fowler, Lancaster & Co. *Sup.* 11 & 12
J. T. Gent & Co. ... ...
A. B. Gill & Co. 6
Hartmann & Braun ... ...
International Electric Co. *Sup.* 7
King, Mendham & Co. ... *Sup.* 6
Laurence, Scott & Co. ... ...
W. Moseley 6
PAGE
Manufacturing Electricians.—*Cont.*
Nalder Bros. ... ... *Sup.* 9
J. Orme & Co ... ... *Sup.* 8
Price, Talbot & Co. ... *Sup.* 2
Telegraph Mfg Co. ... *Sup.* 2
H. Thorpe 6
Walsall Electrical Company ...
Woodhouse & Rawson United ... 11
F. Zöpke ... ... *Sup.* 16
Mica.
R. McGoune, Buchanan & Co. *Sup.* 12
F. Wiggins & Sons 3
Motors.—Cuttriss & Co. ... ...
Gülcher Electric Light & P. Co. 13
Patent Agents.—H. Gardner ... 3
Poles.
Johnson & Phillips (Wood and Iron). 1
Joseph Aird (Wrought Iron and Steel). 2
Porcelain Appliances.
Dorman & Smith 9
Genl. Elec. Co., Ld. (G. Binswanger.) *Sup.* 10
W. Wood & Co. ... ...
Porous Cells.—J. Stiff & Sons ...
Pulleys, Shafting, &c.
J. Braithwaite & Son 12
J. Jardine ... ...
Railway Signals.
Saxby & Farmer 10
Schools and Classes.
Electrical Standardising Inst. *Sup.* 12
Owen's College ... ... *Sup.* 12
School of Telegraphy 19
Screws.—Davis & Timmins 18
Switches.
Appleton, Burbey & Williamson *Sup.* 18
Faraday & Son 10
Genl. Elec. Co., Ld (G. Binswanger.) *Sup.* 10
The Paiste Switch... ... *Sup.* 3
Walsall Electrical Co. ... ...
Woodhouse & Rawson United ... 11
Telegraph Engineers.
Johnson & Phillips 1
Telegraph Mfg. Co. ... *Sup.* 2
Telephones.—Baughan & Co. ...
Consol. Tel. Const. & M. Co. *Sup.* 8
Stanhope Co. 6
Universal Telephone Co. ... ...
Tools.—Chas. Churchill & Co. *Sup.* 7
Tubes.—Joseph Aird 2
Turbines.—F. Nell ... ...
Vulcanite (see Ebonite).
Watches (Non-Magnetic.)
H. W. Bedford ... ... *Sup.* 6
Wire (covered).
Fowler-Waring Cables Co. ...
W. T. Glover & Co. 2
W. T. Henley's Telg. Works Co. ... 4
London Electric Wire Co. *Sup.* 1
Midland Electric Wire Co. ... 13
Phillips Bros. 19
W. Rickard ... ...
Telegraph Mfg. Co. ... *Sup.* 2
United Electric Wire Co.... ... 6
Woodhouse & Rawson United ... 11
Wire (uncovered).
Davis & Timmins 18
Ramsden, Camm & Co. 13
F. Smith & Co. 3
Wire Covering Machinery.
T. Barraclough & Co. 6
Wood Casings.—S. Elliott ... *Sup.* 16
Genl. Elec. Co., Ld. (G. Binswanger.) *Sup.* 10
J. F. & G. Harris ... ... *Sup.* 9
Vigers Bros. 13
Woodhouse & Rawson United ... 11

BOOK ADVERTISEMENTS APPEAR ON Page 14 OF SUPPLEMENT.

MISCELLANEOUS ADVERTISEMENTS *relating to Situations, Articles for Sale and Wanted, &c., &c., appear on Sup.* 11 *(middle of paper.)*

CROMPTON & CO., LIMITED SEE SUP. 20.

Telephone No. 2,814.

Telegrams: "Faraday," London.

FARADAY & SON'S

ELECTRIC LIGHT FITTINGS.

Edinburgh Exhibition—Stall No. 87.

3, BERNERS STREET, W.
Works: 9 & 10, NEWMAN MEWS.

INTERLOCKING THE LOCK AND BLOCK.

The Board of Trade have again and again urged the necessity of combining the "Lock" and "Block" systems by actual connection between the Telegraph Instruments and Locking Levers, to effect "inter-dependent working." This great improvement, together with Supplementary Automatic Train Action, has been reliably accomplished and brought into practical use on several lines by Messrs. SAXBY & FARMER, under protection of various Patents granted or assigned to them. For Particulars, Plans, and Estimates, apply to

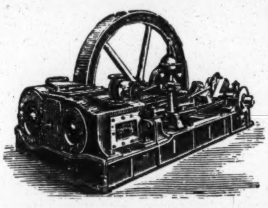
SAXBY & FARMER, Railway Signal Contractors Canterbury Road, KILBURN, LONDON, N.W.

Manufacturers of Railway Signals, Cabins, Interlocking Levers, Block Instruments, and Signal Work of every description, Electrical and Mechanical. 1443

DAVEY, PAXMAN & Co., Engineers, COLCHESTER,

Devote special attention to

STEAM ENGINES AND BOILERS REQUIRED FOR ELECTRIC LIGHT INSTALLATIONS.

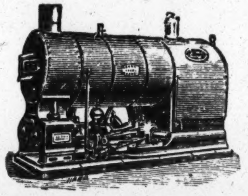


Compound Fixed Engine.
8 to 100 H.P. nom.

D. P. & Co.'s Engines are the cheapest, most durable and most reliable in the market.

Competitive Trials at Newcastle, July, 1887 open to all Makers. The only prizes offered by the R.A.S.E. for Steam Engines, &c. £200 for Best Compound Portable Engine, £100 for Best Single Cylinder Portable Engine, were awarded to D. P. & Co.'s Engines for Extreme Economy in Fuel, Excellence of Design, and Smooth and very Regular Working. This record is 54 per cent. lower than that of the most Economic Engine at the Cardiff Trials in 1872.

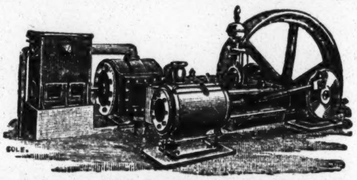
Telegraph Address:—
"PAXMAN, COLCHESTER."



Patent Semi-fixed Compound Engine and Boiler. 8 to 70 H.P. nom.

Catalogues, Price Lists, and full particulars Post Free on application to

MAKERS OF
Portable Engines. Semi-Portable Engines.
Semi-Fixed Engines and Boilers.
Horizontal Engines. [ing Engines.
Vertical Engines and Boilers. Horizontal Wind-
Vertical Hoisting Engines and Boilers.
Compound Portable and Semi-Portable Engines.
Compound Semi-Fixed Engines and Boilers.
Compound Horizontal Fixed Engines.
Cornish, Lancashire, and other Boilers.



Horizontal High Pressure Coupled Compound Engine. 12 to 100 H.P. nom.

PARIS EXHIBITION, 1889.

D. P. & Co. have been awarded Two Gold Medals and One Siver Medal for their Steam Engines and Boilers.

DAVEY, PAXMAN & CO., Engineers, COLCHESTER.

LONDON OFFICE: 139, QUEEN VICTORIA STREET, E.C. 2066

INCANDESCENCE LAMPS.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, Ltd., hereby give notice that they have acquired the Edison, Lane-Fox, and other Electric Lighting Patents, for AUSTRALASIA, INDIA, the CAPE OF GOOD HOPE, and NATAL, and that it is an infringement of the rights now secured by assignment to them to import, sell, manufacture, or use an INCANDESCENCE ELECTRIC LAMPS in those territories, except under their License.

All orders for Lamps intended to be used in India, or in the above-mentioned colonies, must be referred to the BRUSH ELECTRICAL ENGINEERING CO., Ltd., 112, Belvedere Road, LAMBETH, S.E., from whom quotations and full information may be obtained on application. 3830

Telephone No. 3975. Telegrams: "DETECTOR, LONDON."

RASHLEIGH PHIPPS & DAWSON.

SHOW ROOMS: 53, BERNERS STREET, LONDON, W.

The Best and most Artistic Show of Fittings in London.

ELECTRIC LIGHT ENGINEERS AND CONTRACTORS.

COMPLETE INSTALLATIONS, OR WIRING ONLY, CARRIED OUT PROMPTLY. ALL WORK GUARANTEED. TRADE SUPPLIED.

NEW PATENT CEILING ROSE,

Approved by all the Fire Offices and Supply Companies, 1s. 1d. net. "The most Perfect Ceiling Rose in the market."

WORKS: WELLS MEWS, W. 3211

AUG 26 1890

THE TELEGRAPHIC JOURNAL AND

ELECTRICAL REVIEW.

VOL. XXVII. AUGUST 15, 1890. No. 664.

CONTENTS:

	PAGE
The Debate on the Telegraph Estimates	173
Elihu Thomson's New Alternator	175
Field's Mercury Thermal Cut-out (*illustrated*)	177
New Cable Railway	177
The Nichols Patent Lamp Holder (*illustrated*)	178
The Reichenhall Central Station	179
Prof. Thomson's Latest Dynamo (*illustrated*)	179
Thomson's Electric Meter (*illustrated*)	180
Experiments with the Sims-Edison Torpedo *illustrated*)	181
The Electric Resistance of Gas in Magnetic Fields	182
Electrolytic Theories	183
The Dynamo as a Motor	184
King, Brown & Co. *v.* The Anglo-American Brush Corporation	184
Reviews :—Dictionnaire d'Electricité et de Magnétisme	185
Journal of the Institution of Electrical Engineers	185
Notes	185
City Notes, &c. :—Maxim-Weston Electric Company	189
City and South London Railway Company	190
Chili Telephone Company	190
Liverpool Overhead Railway Company	191
Traffic Receipts	191
Share List of Electrical Companies	192
The Ries Electric Traction-increasing System (*illustrated*)	193
Parliamentary Notes	194
Thunderstorms	194
Ship Lighting Plant	197
Proceedings of Societies :—	
The Institution of Electrical Engineers	197
New Patents	198
Abstracts of Published Specifications	199
Correspondence :—The Lineff System of Electric Traction	200
Fall of Potential	200

THE DEBATE ON THE TELEGRAPH ESTIMATES.

THE recent passing of the telegraph estimates was characterised by an important and interesting debate. Important—because of the magnitude of the sum involved, and the extent of the service it promotes, and interesting on account of the absence, for once in a way, of those dry details and monotonous columns of figures common to the passing of estimates generally.

There were a few complaints at the outset as to the slow development of telegraphic communication in the more remote parts of the Highlands; a difficult matter in which to suggest any specific course; some general remarks at the conclusion from several hon. members as to the Carté system of telegrams as observed in Paris and elsewhere on the Continent; a system said to be cheaper than our own, but less expeditious, and therefore of doubtful value to the commercial world; comments on the non-purchase of the telephone interest, and the question of overhead and underground lines; but these points cannot be said to have affected the general character of the vote.

The more prominent features of the debate were those raised by Earl Compton and Sir E. Reed. Indeed, Earl Compton and Sir Edward had openly expressed their intention of bringing matters affecting the telegraph service before the House on the discussion of this vote.

Whatever the Postmaster-General thinks of what he sarcastically terms the "endeavours of philanthropic politicians" in encouraging remedial agitation, he has but little reason to complain of the splendid and effective opportunity with which they provided him for the display of his own ideas of philanthropy and justice on the occasion under notice.

Earl Compton considered the answers given in the House of Commons from time to time, with reference to the Telegraph Department, very unsatisfactory. He disclaimed party motives, and had not taken any active part amongst telegraph clerks, whose movement had been conducted legitimately and constitutionally. What they had done had been effected without the aid of paid or political agitators.

The Postmaster-General deprecated the interference of third persons between the Department and its servants.

The noble lord, on broader than departmental grounds held that departmental servants were, after all, the servants of the public, and not of the Postmaster-General; on that ground hon. members had a right to interfere, if the exercise of constitutional and legitimate methods had failed to remove complaints of improper treatment.

Earl Compton evidently feels that the responsibility of the member to his constituency is of as much importance as is the reponsibility of a minister of State to the House. Few will deny the soundness of this principle.

Proceeding into details of work, pay, and promotion in the Telegraph Service throughout the country, the noble lord displayed a surprising mastery of his subject, his knowledge of details being extensive and accurate. He complained of evasive replies; of a difference between "Hansard" and *Times* reports, and preferred the latter. With reference to public meetings, he strongly advised the Government to allow civil servants to meet without interference, and took up much of the ground held by us in our leader of the 1st inst. He acknowledged that the Postmaster-General's scheme was infinitely better than he expected; but was the Fawcett £190 class to be replaced by a new £160 class?

This is the point on which the whole success of the new scheme turns. It is the point, too, which is still in abeyance.

Lord Compton dealt at some length on these and a number of other points, and, in moving the reduction of the vote by £150, said though the Postmaster-General had had a great deal of trouble, he thought much of it was due to his want of sympathy with those under him, but he still had a great opportunity of reinstating himself in the affections of those over whom he was placed.

The noble lord's remarks were characterised by the temperate and yet candid manner in which they were presented, and he had a sympathetic following throughout.

Sir E. Reed, true to his promise, dealt forcibly yet fairly with what is known as the "Cardiff exiles" incident. Our readers will probably remember the circumstances of the case, and we need not reproduce them here. Sir Edward took up a very strong public position at the time, and from that position he has not swerved. He, too, disclaimed party aims, and said he was not anxious to make himself a medium for ventilating grievances in that House; and here he gave one of his cutlass-like slashes, just by way of a change, adding, particularly during the *régime* of the present Government. While he declined to unduly harass the the Government, yet he thought there had been a desire to exercise arbitrary authority; but in this age discipline was not to be maintained by such measures. The House cheered this sentiment. He dealt trenchantly with the "exile" question. He had gone into the charge brought against the men; that charge was entirely without foundation. He strongly disapproved of the restriction of public meeting; any Post Office official inviting half a dozen of his colleagues to dinner, at which matters of interest to themselves were discussed, would be liable to dismissal.

The Postmaster-General had seen the gross absurdity of any such regulation.

By responding to the appeal to remove the grievances which Post Office *employés* were suffering under the Postmaster-General would probably save them the trouble of dividing on the vote. Another hon. member pointed out, as we have already done, that the order of 1866 was a dead letter.

The Postmaster-General rose, primed and loaded, apparently, with philanthropic anxiety and goodwill. In no other way can we record the spirit of his reply to his Parliamentary assailants.

We have already said that the Postmaster-General has but little reason to complain of the splendid opportunity held out to him by "philanthropic politicians," amongst whom he includes, presumably, Lord Compton and Sir Edward Reed.

Whether he does, or whether he does not, he nevertheless owes these hon. members a debt of gratitude. He had such an opportunity of vindicating his anxious zeal in the interests of telegraph clerks, that the absence of Lord Compton and Sir Edward Reed from the debate would have been little short of a catastrophe for him.

He hoped to maintain the temperate tone displayed by the noble lord. In sorrow, with just the necessary dash of anger, he rebuked the noble lord for disparaging "Hansard." Notwithstanding "the cannonade by insolent vituperation hurled at the head of the Department," complaints would receive the favourable consideration of the Government.

He hoped he had abstained from the use of irritating language. He thought it strange that he, who had been the only Postmaster-General since Mr. Fawcett had been able to secure for the telegraphists permanent benefits, should be attacked as one guilty of unsympathetic and arbitrary dealing. He was happy to think, however, that he had been able to give to the telegraphists substantial proof of his consideration. On the subject of the prepared evidence for the Royal Commission, and which was at first sent through the "higher officials," the Postmaster-General was hazy and uncertain. He did not know much about that case. He admits, doubtless, that it was urgent. On several other points a want of knowledge also provided a ready escape.

The Postmaster-General then graciously took the House into his confidence, gloriously detailed the reforms and concessions in his scheme, and pathetically remarked that he had done all he could to show his regard for those under him.

The House heard these concessions in an appreciative spirit, as also the statement that with reference to the vexed question of maximum pay in the Central Department, telegraph clerks would find that their position would not be damnified, but improved. The Postmaster-General, notwithstanding all these advantages, is glad that he has not got to do the work of a telegraph clerk. Telegraph clerks ought not to lose sight of these statements.

Continuing to display a broad and almost amazing philanthropy, on the subject of public meetings, the Postmaster-General said the new regulations were intended to express to the servants of the department the "benevolent disposition" of their superior officers. This "benevolence" does not seem to extend to reporters who are not "official," as the Postmaster-General doubts the accuracy of their reports, and in this matter it will be seen that he, like Lord Compton, finds considerable variance amongst reporters.

In fact the Postmaster-General appeared to be running over with amiability, and the last good natured volley, in what many will call a remarkable speech, was made up of expressions of justice, kindness, benevolence and goodwill to everyone in his great department, and which department he ventured to hope he had not unworthily administered. It is not surprising that this speech disarmed further opposition, and that the vote was agreed to without a division.

From rebuking the "philanthropic politician" it will be seen that the Postmaster-General has arrayed himself from head to foot in a gorgeous and resplendent mantle of philanthropy. We trust the texture of this garment is not too transparent.

It remains for him now to see that his scheme is not tampered with by those who come between him and those to whom he has expressed such unbounded goodwill.

It will be worth his while to prevent delay in the general application of his reforms to the telegraph service, and to be careful that officialism does not underate those points which have enabled him to pose, in what it is to be hoped is something more than a well simulated philanthropy before the House of Commons and the country. Already we hear of men being punished for what they have said, and also of one man's dismissal on this score.

Many will ask if this is a specimen of the exercise of that "benevolent disposition" referred to in the Postmaster-General's speech.

If the whole thing is not an absurd and ill-timed parody, the Postmaster-General will see that his deeds outside the House are equal to his promises in; it will then be fully admitted that a little practice has lent additional value to much precept.

ELIHU THOMSON'S NEW ALTERNATOR.

IN designing the machine, which figures on another page, the main object seems to have been to avoid the use of moving coils in an alternator having iron in its armature. The only machine made in this country and designed with the same object is, we believe, the alternator of Mr. Kingdon, about which, however, there has been up to the present a remarkable scarcity of data. But the idea is by no means new. In 1883 the late Mr. Charles Lever designed a machine in many respects similar to that of Professor Thomson, which was made for him by Messrs. Paterson and Cooper, and when finished, tested at their works.

The magnetic wheel or rotating pole-piece consisted of a star-shaped piece of wrought iron, like Professor Thomson's, but with eight spokes, while the fixed coils, 32 in number, arranged 16 on each side of the wheel, were wound on cores formed of split tube filled up with iron wire and attached to cast iron ring cheeks. The star wheel was carried by two upright magnets, and had all its spokes of the same magnetic polarity, while the lines of force completed their circuits in the machine by passing from the spokes through the cores of the fixed coils, then from the ring cheeks to the sole plate supporting the two magnets.

The points in which that machine resembled this of Prof. Elihu Thomson will be at once observable. It remains but to add that, when it was tried, Mr. Esson proposed a modification which would have made them almost identical, consisting in substituting for the two circles of coils on the sides of the spokes, one circle only to be wound on cores projecting inwards from a ring outside the spokes. But after experimenting for some time, Mr. Lever gave the machine up; for what reason we do not know. That he had a fairly clear notion of what he wanted to do is certain, though consequent on the state of knowledge at the time, his ideas were but imperfectly carried out. The magnetising coils induce in these machines a field having several separate paths, each of which is intercepted by a fixed armature coil. There is in each path a considerable air gap, and it is the function of the magnetic wheel to close and open in succession these gaps, so determining the successive magnetic paths the lines shall take, and inducing an E.M.F. in the fixed coils. Though there is no actual reversal of magnetism in the coil cores, there is a considerable surging of the field, and to avoid the heating which would otherwise result, both the magnet wheel and the coil cores require to be laminated. This is done in both the Zipernowski and Kingdon machines, which Thomson's, to some extent, resembles.

Invention made Easy. SEVERAL American exchanges just to hand give descriptions of converters and dynamos, devised by a Mr. De Castro, of New York, having their cores made up of iron filings. It is evident from the drawings which accompany the descriptive matter that the information given has been culled from a patent specification, and not derived from the results of practice. Respecting the construction of dynamo armatures we read that "experiments which the inventor has made lead him to believe that by the employment of cores of subdivided iron or iron filings in lieu of solid cores, he can secure inductive effects of much greater intensity than heretofore and effect a considerable economy of electric energy and insure the conversion of a greater number of lines of force or energy than has heretofore been possible." Mr. De Castro must be sadly behind the time, both with regard to subdivided iron and also filings. Of the former it is unnecessary to speak, and of the latter we need only remark that cores so made are absolutely useless. In 1879, Profs. Ayrton and Perry had a dynamo so constructed at the works of Messrs. Clark & Muirhead, and, perhaps, these gentlemen will be so kind as to enlighten Mr. De Castro on the results obtained by them, and so save him the expenditure of further time and money. Induction apparatus with iron filing cores had been tried, we believe, by Cromwell Varley, amongst others, previous to that date, and we cannot conceive how it is that so many of our American contemporaries continually insert descriptions of so-called new inventions without the slightest attempt to put the patentee on his guard against proceeding with old, abandoned, and useless ideas.

Thunderstorms. THE article which we publish on another page will prove of interest to students of the phenomena of atmospheric electricity. There is no doubt that Prof. Oliver Lodge has recently done much to awaken an interest in the action of lightning, and it is just such papers as Mr. Hazens which are required to give one a good idea, in popular form, of the complex nature of thunderstorms.

Electric Torpedoes. ALTHOUGH the Edison-Sims torpedo has been previously mentioned in our pages, it has not hitherto been noticed in such a complete manner as in this issue. It will be found interesting not only to military and naval readers, but also to the electrician.

Open to Doubt. A TELEGRAM from Washington, dated August 9th, reads as follows:—"In view of the universal interest aroused by the Kemmler execution, an accident which occurred to-day to an *employé* of an electric light company at Washington has evoked great attention. By an inadvertence the man received a shock of 2,000 volts. He became instantly insensible, but soon recovered, though the places where the current entered and left his body showed marks of burning, and were very painful." It is easy to get such a paragraph as this noised abroad with a view to show that there could have been no certainty that the electrical plant used upon Kemmler would send him into eternity swiftly and painlessly; but what is there to prove that the Washington workman received a shock from a pressure of anything like 2,000 volts? Moreover, we believe that the Westinghouse high tension system is employed in Washington, so the story of this wonderful escape from death may be open to various constructions.

Photographs of Water Drops.

THE demonstrations given by Mr. C. V. Boys of his photographs of falling water drops are well known, and Lord Rayleigh recently remarked that it had never occurred to him as being possible to obtain enough light from a single spark to photograph the drops as Mr. Boys has done, and he attributed this success to the fact of his using no lenses, which would absorb the ultra-violet rays. It is not, however, so generally a matter of common knowledge that Mr. P. Lenard succeeded very well some years ago in photographing water drops, falling through air, with single sparks, the light of the spark passing two glass lenses and the objective of a camera which gave magnified images. Copies of Mr. Lenard's productions appeared in the *Annalen der Physik und Chemie*, Vol. XXX., 1887, and show all the forms obtained by Mr. Boys. It may be interesting to state that Mr. Lenard has a paper in the same journal, No. 4, 1890, entitled :—"Leitungswiderstand von Wismuthdraht im Magnetfelde für Constante Ströme und Electrische Oscillationen."

Too Modern.

Modern Light and Heat is too modern. In its issue of the 31st ult., we note the following :—"The electric railway accident in Boston on Saturday last by which two horses were killed was certainly an unfortunate one. It is a well-known fact that dumb animals, horses in particular, are of very sensitive nervous organizations and unusually susceptible to the electric current. That the public need have no more fear of the current since this accident than before, is substantiated by the fact that there is not a single case on record where a human being has been killed by a 500 volt current." Now we know of a death which occurred in this country some years ago from a continuous current machine which was running at one of the South Kensington Exhibitions, and when the difference of potential was measured between the places touched by the victim it was found to be 500 volts only. Again, deaths have occurred from alternating current Gramme machines supplying electrical energy to Jablochkoff candles, arranged on separate circuits of five each, the difference of potential necessary to keep the lights burning not exceeding 250 volts.

Telephonic communication between London and Paris.

THE rumours which have been so long floating about in the air concerning this communication are gradually shaping themselves into something tangible. Already, we believe, considerable progress has been made on this side of the water with reference to the matter, materials having been got in hand for the purpose, and we believe that what delay is taking place is wholly due to the authorities on the French side. The French Chamber has now, however, unanimously voted the expenditure of 400,000 francs towards the expense of establishing the telephonic line, and we may, therefore, expect rapid progress to be made. Of the possibility of working between the two capitals there can be no doubt, it is simply a matter of proportioning the dimensions of the cable cores and the aerial conductors, so as to bring the "KR" well within the value that it is known will give clear speaking, and this will be attainable without having them of very unusual size.

Church Lighting.

THERE has not been a great rush on the part of the clergy and parishioners of the various churches to have the electric light installed in these sacred precincts. Of course, many reasons could be given for this. It would seem, perhaps, inadvisable to erect special plant, but in the case of a church or place of worship being in the neighbourhood of a central station, the question is a simple one. This, no doubt, has influenced the vicar and churchwardens of St. Jude, Kensington, who have concluded arrangements with the House-to-House Company, as notified in another column.

Cable Laying made Easy.

THE Bootle *Times* has a remarkable contributor to its columns, and his articles on "Submarine Navigation" have been reprinted in pamphlet form. We do not think that this literary giant has even a method in his madness, as witness the following plan for utilising submarine boats in cable laying operations :—"The saving in time and cost of laying deep-sea electric cables, if these cables were guided to their resting place by a submarine vessel, would pay over and over again for the cost of the boat, and we should hear very little of disconnections and fractures in mid-ocean. The indirect gain would doubtless be much greater than even the saving in cost of surveying, laying, and subsequent repairs."

The Compound Winding Case.

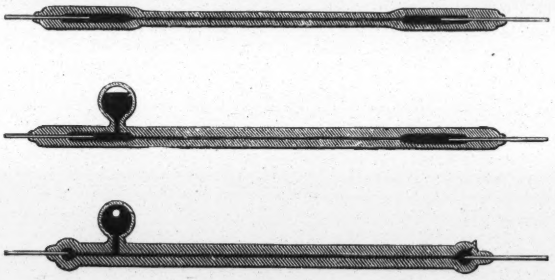
IT is with regret that we learn of the intention of the Brush Electrical Engineering Company to appeal to the House of Lords against the judgment in the Scotch Courts. We can scarcely hope that the electrical trades will make any effort to resist the application of the company, because it is probably thought that even if the appeal is successful they have not much to lose considering that the duration of Brush's patent is nearly at an end; however, it must not be forgotten that there may be such an infliction as the payment of back royalties. We would gladly see some friendly pressure brought to bear upon the company, for after being fairly and squarely beaten on two occasions the present intimation looks too much like the last throw of the gamester, and people may be apt to think that there are other motives than the mere desire to sustain Brush's patent to account for the attitude which the company has seen fit to adopt; indeed, it seems possible that financial considerations may have had considerable weight in bringing the directors to their decision. Mr. Varley has on another page again drawn attention to this matter, but as the above remarks were penned before his copy reached us, we do not hold ourselves in the least degree responsible for his utterances, which must naturally be of a partial character.

FIELD'S MERCURY THERMAL CUT-OUT.

THE protection of telegraph and telephone apparatus from abnormal currents, says the *Electrical Engineer*, New York, has led to the construction of a large number of cut-outs, both electro-magnet and thermal in their nature. In order to avoid the introduction of an electro-magnetic device which might introduce retardation, and, on the other hand, to overcome the objection to lack of uniformity and fragility in fine fuse wires, Mr. Stephen D. Field has recently invented an ingenious cut-out in which mercury is employed as the fusible, or rather volatile, material. Another object aimed at is to obtain such a construction that upon the cessation of the abnormal current the circuit to the instrument is automatically restored without the replacement of any material in the cut-out.

The simplest form of Mr. Field's cut-out is illustrated in the accompanying engraving, fig. 1. It consists merely of a glass tube with a fine bore, which is filled with mercury, and has two conducting wires sealed in at the ends. The passage of an abnormal current heats the mercury, vaporises it, and the pressure generated bursts the tube, thus rupturing the circuit.

In order to provide for the automatic closing of the circuit above referred to, the construction shown in fig. 2 is employed. Here a chamber is placed at one end of the tube, which is part filled with the mercury. The air, which occupies a portion of the chamber, being an elastic medium, allows the expansion due to the vaporisation of the mercury in the capillary portion to take place without rupturing the structure, as the air becomes compressed and the separation of the column of mercury in the capillary tube can take place, thus opening the circuit in a reliable manner without destroying the apparatus.



FIGS, 1. 2, 3.

Another form of cut-out, shown in fig. 3, is similar to that shown in fig. 2, except that instead of leaving an open air-space in the chamber, a rubber ball filled with air is placed in it and the chamber completely filled with mercury. This prevents the escape of the air from the chamber into the capillary tube in transporting or handling the apparatus, while affording a sufficiently elastic medium to preserve the apparatus from destruction by the vapour-pressure generated in its operation.

Among the practical advantages claimed by Mr. Field for this form of cut-out, are first, that, if using only pure distilled mercury, it is possible to have absolute uniformity in the conductivity of a given size of cut-out. Again, the construction of capillary tubes of glass has reached such a stage of perfection that it is entirely practicable to have a given diameter uniformly reproduced ; and, furthermore, the diameter may be very much smaller than it is possible to draw any of the known fusible wire metals or alloys. Again, mercury has a very high coefficient of resistance. It therefore becomes possible and entirely practicable to construct thermal cut-outs of this character so as to permit an exceedingly small fraction of an ampère to volatilise the mercury at the point of least diameter, and the action will take place invariably at the same critical temperature. We have seen the cut-out in operation, and it seems to fulfil all the claims made for it by Mr. Field.

NEW CABLE RAILWAY.

A NEW cable railway, in which electricity takes an important part, has been opened on the Monte San Salvatore, in Switzerland. The line commences a few yards above the level of the Lake of Lugano, with a gradient of 17 per cent., crosses the cutting of the Gothard railway by means of light iron bridges, and reaches the middle station at Pazzallo, with a gradient of 38 per cent. in 540 yards. The working plant is installed at this station, from which the second stretch of single line is continued to the summit of the mountain. This portion of the line begins with curves of 325 to 433 yards radius, with a gradient of 38 per cent., and terminates 26 yards below the summit. The total length of the railway, which is of one metre gauge, is just over one mile. In the middle of the track is a double rack rail on the Abt system. Two passenger cars run on the railway in such a manner that when the one on the lower portion is ascending, the other on the upper line is descending.

The track rails are bolted to sleepers laid on a masonry foundation. The cable consists of a cast steel wire rope $1\frac{1}{3}$-inch diameter, running over grooved pulleys at the working middle station. Throughout the whole length of the line the cable is supported at intervals of from 13 to 16 yards by means of rollers hollowed in the middle. These rollers are 16 inches long and 8 inches in their smallest diameter. Larger rollers, made of iron and lagged with wood, are used round curves in order that the bite of the cable may be increased. Each car weighs $4\frac{1}{2}$ tons, and contains four compartments, accommodating, in all, 32 passengers. The cable is attached to the underside of the car on one side. Each of the two axles to each car has fixed to it two rack wheels which engage with the before-mentioned rack when the car is in motion. Fixed on each axle are two brake pulleys, which are connected by means of two chains with two pairs of brake blocks. One of these brakes is connected with a crank lever on the driving platform by a shaft and suitable gearing, whilst the other three brakes are automatically applied if the cable becomes slack or breaks. The latter can also be worked by the driver pushing a lever with his foot. When either the hand or automatic brakes are used, they are applied to the axles of the car, thus preventing their revolving, whilst the rack wheels keep the car in a stationary position.

The working station at Pazzallo contains a 40 H.P. motor, series wound, running at 700 revolutions a minute. A 50 H.P. portable boiler and engine is provided as reserve, in case of repairs being made at the water-power station, or if a breakdown should take place. The motor or engine, as the case may be, drives, by means of belting, a countershaft, running at 138 revolutions. On this countershaft are fixed two bevel wheels and two friction wheels. A second countershaft, placed at right angles to the first, has arranged at one end a bevel wheel, which engages with either the one or the other of the two bevel wheels on the first shaft, and causes the second shaft to revolve in either direction as desired. There is also provided a third shaft, upon which the large driving pulleys revolve. The second shaft carries two brakes, one being for hand regulation, and the other being applied automatically when the cars are at the middle station, by the vehicles pushing over two levers. The working station is in charge of an engineer, who operates the hand brake and a regulating wire resistance, whilst an ammeter at the upper station controls the current. The two termini and the middle station are connected by telephone, and the latter is also in telephonic communication with the power station at Maroggia. Electric bells serve to announce the arrival and departure from the termini to the middle station, and *vice versâ.* Throughout the whole length of the railway is arranged, almost in contact with the outside roof, an electric conductor which, on the driver moving a switch, closes a circuit. This contrivance permits of signals for backward or forward movement of the car being transmitted to the engineer at the working station.

The power for operating the railway is obtained from a fall of water, which is led down an iron tube 20 inches in diameter, and 370 yards long. The available power is estimated at 700 H.P., and the lower end of the tube terminates at the generating station, which is situated near the Maroggia station at the south end of the Lake of Lugano. At present the water-power is only used to actuate two Girard turbines having horizontal axes, and driving two Oerlikon dynamos direct. One of these dynamos is a continuous current machine, and the other an alternator having its exciter placed on the same spindle. The continuous current dynamo is used for transmitting the power, whilst the current from the alternator is, by the intermediary of transformers, used for lighting the town of Lugano and the cable railway stations. The alternator, which runs at 600 revolutions at an E.M.F. of 2,000 volts, supplies current to 1,500 16-C.P. lamps, which are installed in the local hotels, restaurants, &c. The price for light is $\frac{1}{4}$d. per lamp hour.

The continuous current dynamo is series wound, runs at 700 revolutions, and has an output of 22 ampères at 1,800 volts. The machine has been built for delivering 60 H.P., and is automatically prevented from being overloaded. The current from this dynamo is led to the motor at the Pazzallo station by 5 mm. copper wires arranged on the two-wire system, and carried on oil insulators placed on poles. The loss in E.M.F. at full load amounts to $16\frac{2}{3}$ per cent. Thus the motor receives 22 ampères at 1,500 volts, this giving an output of the motor of 40 H.P. and an efficiency of 66 per cent. The distance from the generating station to the motor is about five miles. Suitable regulating apparatus is provided at the Pazzalo station. On ordinary days there are four journeys up the mountain and four downwards, but on feast days and at holiday time the cars make 24 journeys. The time occupied in transit from one terminus to the other—the speed being one metre per second—is about 30 minutes. The fare is 2s. 6d. for the up, and 1s. 3d. for the down trip, or 3s. 3d. there and back; on holidays these charges are reduced by half. The total cost of the installation, exclusive of conductors and turbines, has been £24,000. The undertaking has been carried out by Messrs. Bucher and Durrer, of Kägiswyl, and the railway was opened a few weeks ago.

THE NICHOLS PATENT LAMP HOLDER.

MOST of our readers must have often remarked on the clumsy appearance given to arc and other electric lamps which required to be lowered to replace the carbons, or for cleaning, by the long loose loop of cable hanging at the side, as illustrated in fig. 4, the dotted position showing the lamp lowered for adjustment and the upper position showing it when working.

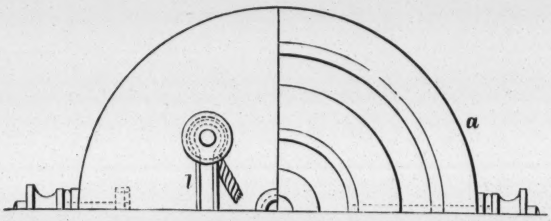


FIG. 1.

The necessity for this slack cable may be entirely avoided by the use of Nichols patent lamp holder, which we illustrate in figs. 1, 2, 3. Fig. 1 being a half plan, one quadrant showing the terminal and the other showing the inner face. Fig. 2 is an elevation half in section, and fig. 3 a plan of the inner face of the lower half. The holder consists of two parts, *a* and *b*, made of slate or other non-conducting material, the part *a* is to be fixed to the ceiling or roof from which the lamp hangs, and the part *b* carries the terminals to which the lamp is attached.

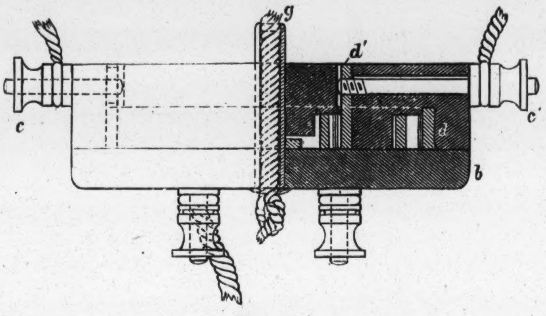


FIG. 2.

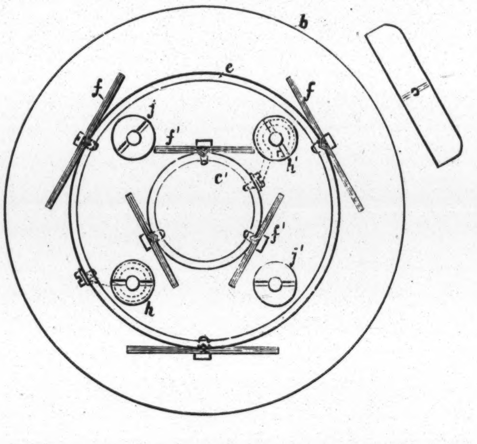


FIG. 3.

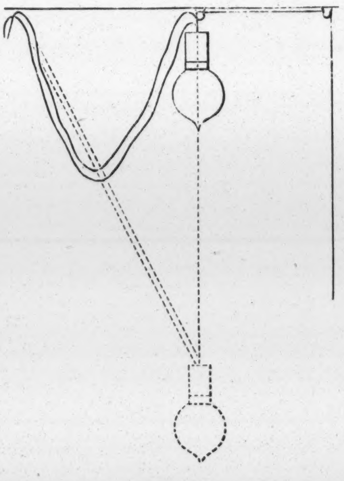


FIG. 4.

The part *a* is provided with two terminals, *c* and *c'*, to which the main leads are attached and each terminal is connected to a gun metal ring, the terminal *c* to the outer ring *d*, and *c'* to the inner ring *d'*. The part *b* is, as will be most clearly seen in fig. 3, provided with two rings, *e* and *e'*, each fitted with contact plates, *f* and *f'*, made of thin sheet copper or gun metal which make connection with the rings, *d* and *d'*, of the part *a* when by means of the cord, *g*, the part *b* is drawn up. Each ring, *e* and *e'*, is in electrical connection with one of the terminals, *h* and *h'*, and between the terminal *h* and that marked *j* is fixed a fuse, *l*, fig. 1. The terminal *h'* is connected to *j'* by suitable wire and the lamp hung from the terminals, *j* and *j'*, three binding screws may be used instead of four, obviously, if so wished. An arc lamp or incandescent lamp of the Sunbeam type can be hung as illustrated in fig. 5, which shows one lamp lowered by means of the cord, *g*, and the other drawn up into position. The cord passes over small pulleys and can be fixed in any convenient position on the wall within reach of the hand. Where these holders are used in series a switch is provided upon the fixed part *a* which automatically completes the circuit when the lamp is lowered.

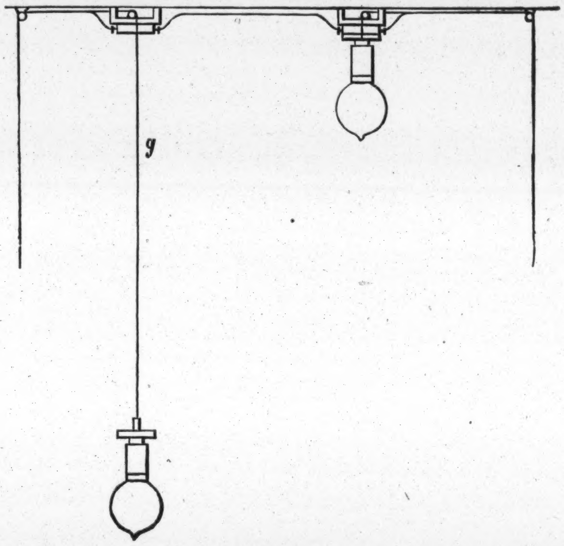


FIG. 5.

Several of these holders are now in use in the Leeds Town Hall and municipal offices where they have given every satisfaction. We are informed that Mr. E. R. Dolby, of 8, Princes Street, Westminster, is prepared to supply any further information.

THE REICHENHALL CENTRAL STATION.

IN May last there was opened at Reichenhall a central station which, for town lighting by transformers, is considered by the *Elektrotechnische Zeitschrift* to be very large. The necessary power is obtained from a mill brook, which is supplied with water from a weir erected in the river Saalach. The length of the brook is about 350 yards, having a fall of nearly 9 feet, and the available water amounts to from 880 to 990 gallons per second. This water actuates a Jonval turbine, yielding, at an efficiency of 75 per cent., from 106 to 120 H.P. It runs at 34·5 revolutions a minute, and transmits power, by means of toothed wheels, to a horizontal shaft which makes 121 revolutions. This shaft carries a pulley, over which passes a belt which drives an Oerlikon alternator at 600 revolutions. The current furnished by this machine is 30 ampères, at 2,000 volts, and the exciting dynamo is mounted on the shaft of the alternator. The current is led by insulated conductors to the switchboard, and the exciting dynamo energises the lamps in the generating room, with the exception of one placed on the switchboard, and which is fed from a small transformer.

The primary current is led overhead through Reichenhall to the St. Zeno Convent, a distance of nearly two miles; and then, further away, to Kirchberg, and several other localities. The aerial conductors consist of two copper wires of 6 mm. cross section, insulated by Johnson and Phillips oil insulators, and carried on masts 49 feet high. At present there are ten transformers used, arranged in parallel. Two of these are for 10,000 watts, six for 5,000, and the remaining two for 1,500 watts. The secondary current is distributed at two distinct tensions: at 100 volts for glow lamps, of which 900 are now installed, and at 50 volts for 118 arc lights. The total loss in the primary conductors is said to be 3 per cent. The installation has been carried out by the Munich depôt of the General Electrical Company of Berlin.

PROF. THOMSON'S LATEST DYNAMO.*

THE accompanying cut shows the details of a dynamo-electric machine so extraordinary in its structure and electrical properties as to be fairly revolutionary; a machine quite as unique in its way as the Duncan motor, to which reference was recently made in our editorial and other columns. The new machine is the invention of Prof. Elihu Thomson, and its special marked properties are total absence of external magnetic field, and almost complete freedom from hysteresis.

Fig. 1 shows a section of the machine. The revolving portion of it consists of a shaft surrounded by a massive iron cylinder, bearing on its central portion the laminated mass of iron that forms the internal pole pieces. The appearance of this part of the machine is shown by fig. 3. This iron mass revolves within a pair of iron sleeves, which carry the bearings of the machine and the magnetising coils, which are thus fixed and wound on bobbins on either side of the revolving poles. The end plates of these massive sleeves are joined by a cylindrical casing of iron, completely shutting in the machine. On the interior of this casing, and immediately surrounding the revolving pole pieces, is a ring with inwardly pointing poles barely clearing the revolving ones. Looped around these poles are the armature coils. The magnetising coils of the machine are so wound as to produce, in the revolving portion, consequent poles of the same polarity in each of the polar projections. The magnetic circuit extends through the internal cylinder and its surrounding sleeves through the outer casing, and forms consequent poles of opposite polarity to the revolving ones in the polar projections that point inward. There is thus no external field whatever.

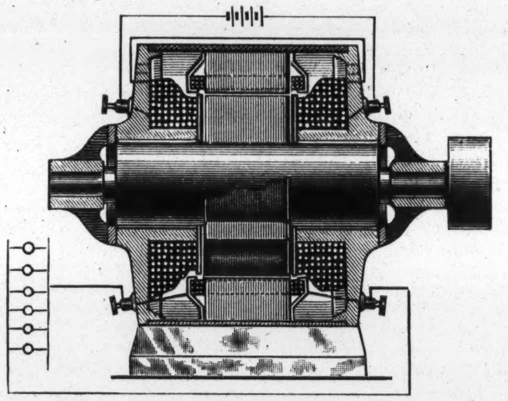


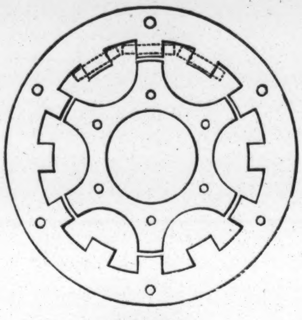
FIG. 1.

The action of the machine is as follows: The moving field poles carried around by the revolution of the core piece pass in front of the coils in which the currents are to be induced. The lines of magnetic force from these pole pieces cut transversely across the wires on the coils, since these lie in the proper direction to be so cut, or at least the sides of the coils parallel to the axis so lie, and in them are generated impulses of current. The direction of the winding and connection is such as to make the effect accumulative in the coils, so that if the polar projection passes (as in fig. 2) over the centre of one coil to that of the next, its lines of force are caused to cut the wire lying between these centres. Impulses of current would thus be set up in both coils, and as the coils are wound each impulse will be superadded. The number of inward pointing poles may be, as in this case, double that of the outward pointing poles; or it may be the same, when the action becomes a simple cutting in succession by the lines of force emanating from the polar projection, of one side of a coil, or of one side of all the coils taken together, and immediately afterward the other side of the same coil or set of coils.

---

* *Electrical World.*

FIG. 2.



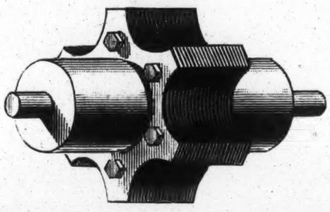


FIG. 3.

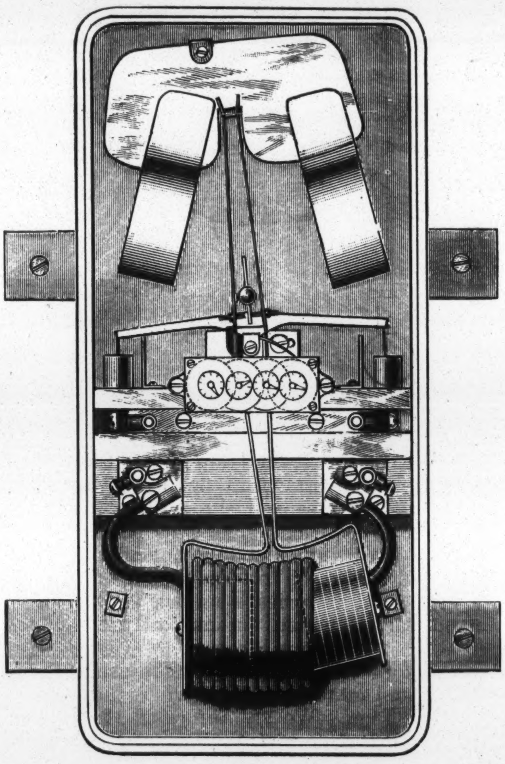
These actions will be repeated in the coils every time a polar projection passes the wire on either side of the coil, so that if there be six poles, and the revolution of the machine be at the rate of 1,000 turns per minute, there would be 6,000 complete alterations of current per minute. These actions of induction will be accomplished without reversal of magnetism in the core piece, or in the laminated ring structure supporting the coils, and hysteresis will thus be reduced to a low amount. Of course, all cannot be obviated, for the reason that there is a changing of the magnetism of the pole pieces in any case; but it will be reduced to a quantity far less than if the same mass of iron were reversed as usual. It is not necessary then to laminate either the revolving or the stationary poles, and it is obvious that the machine, although described as a dynamo, is equally applicable to the construction of an alternating motor that would possess many desirable qualities; or, by the addition of a commutator, be suited to the production of continuous currents.

We think that this description is sufficient to indicate the remarkable properties of the new machine, and although as yet no details of its efficiency are at hand, it certainly appears to be a very simple and effective form of generator or motor. The construction is especially easy and the winding admirable, since there are no moving coils, and therefore no moving contact of any sort, the wires to both field and armature being simply connected to binding posts. The machine certainly is very creditable to Prof. Thomson's inventive genius, and, unless we much mistake, will soon be heard of commercially.

PROF. THOMSON'S ELECTRIC METER.

A VERY ingenious application of Prof. Thomson's beautiful experiments in electro-magnetic repulsion by alternating current, says the *Electrical World*, is to be found in his electric meter, of which a cut is given herewith. It is an exceedingly simple contrivance, and is as effective practically as it is neat theoretically.

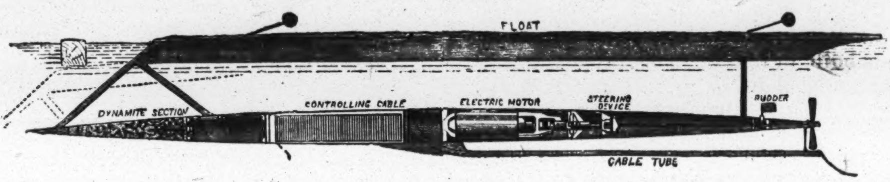
This meter is a modified form of the motor type that measures the current by its direct electro-dynamic action, but, as will be seen, possesses some rather interesting peculiarities. Like most similar devices, it registers the readings directly upon dials like a gas-meter, and can consequently be read by the consumer at any time. This is no small convenience, although perhaps somewhat overestimated, for it is no guarantee of accuracy.

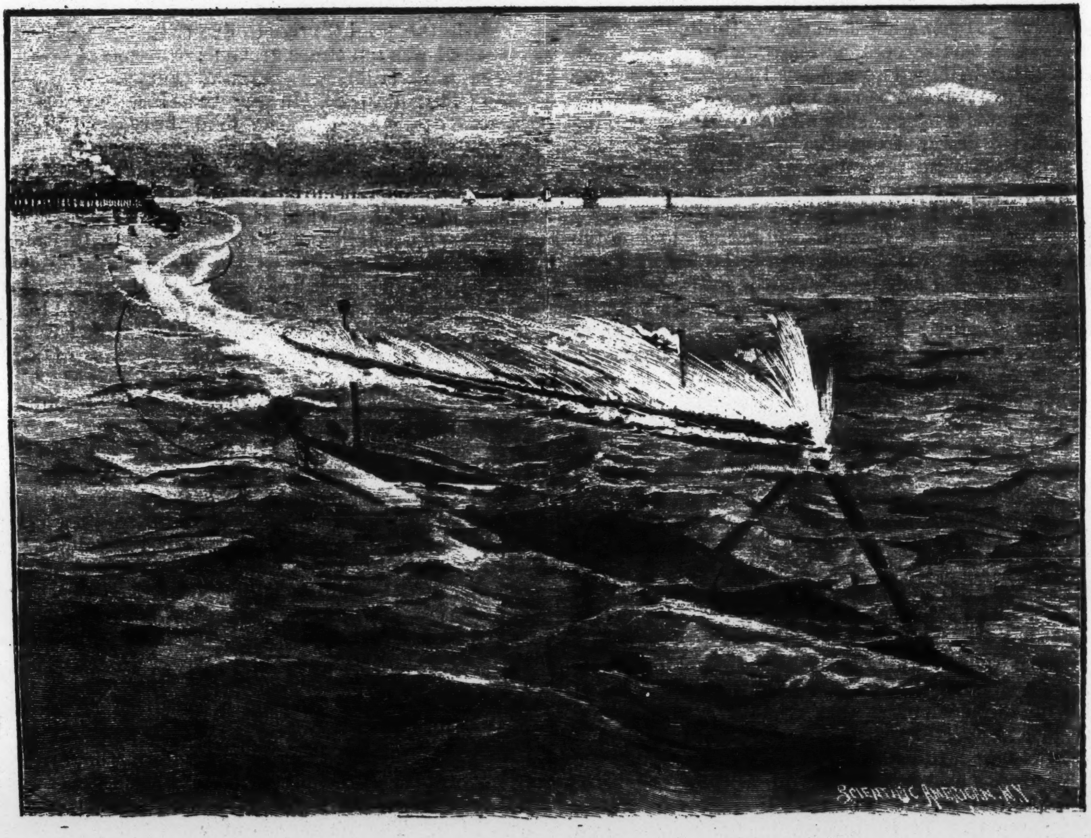


The arrangement consists, as shown, of a single coil of coarse wire wound along a gentle arc. This carries the main current to be measured. Immediately above it is a pendulum, mounted on knife edges, and provided at its lower edges with a pair of coils of fine wire, which are swung inside the solenoid just mentioned. The pendulum is prolonged above the knife edges, and bears at its upper extremity a light copper sheet, which swings in the magnetic field produced by the permanent magnets shown. This delicately poised pendulum is provided with the apparatus intended for registering its oscillations on the dials. The motive power is the repulsive force produced by the solenoid on the two fine coils of the pendulum. These are alternately connected as high resistance shunts across the mains of supply. The main current is thus forced through the actuating solenoid, while a derived current of small quantity energises alternately the two coils on the pendulum bob, being shifted from one to the other at the extremity of the swing by means of the commutator attached near the knife edges of the pendulum. Thus when current is turned on the meter a steady air line is set up, damped considerably by the currents induced in the copper sheet at the upper extremity of the pendulum and checked at either end of the swing by elastic stops. The possibility of using the apparatus as an energy meter is obvious, and altogether it seems a very finished and simple apparatus for registering the amount of current passing through. It is obvious enough that slight modifications will enable it to be used for measuring continuous currents also.

EXPERIMENTS WITH THE SIMS-EDISON TORPEDO.

On Tuesday, July 15th, an exhibition of the Sims-Edison electric torpedo was given at Willetts Point, at the entrance of Long Island Sound, in the presence of a numerous gathering of representative naval and army men and other guests. We *(Scientific American)* have already described and illustrated the general features of the torpedo in this paper, and we reproduce our sectional view of the same in order to recall to our readers' mind its general construction. It consists of a cigar-shaped torpedo and motor case, within which is stowed away upon a reel from one to two miles of controlling cable. The cable is led out through a tube running parallel with the axis of the torpedo and boat to a point aft of and below the propeller wheel. Above the torpedo proper, and rigidly connected thereto, is a float possessing the general outlines of a racing shell, and provided with two sighting poles by which its course can be observed. The hull, if desired, can be filled with cellulose or cork, in order to resist the effects of penetration by shot. In actual trial it has been found to be a very difficult object to hit. The cable is connected to a dynamo at the station, which may be on the shore or in a ship.




SCIENTIFIC AMERICAN, N.Y.

The peculiarities of its action as developed by these features may be summarised thus: As the torpedo progresses the cable is fed from out its body. The result of this is that there is no cable to be dragged through the water; the torpedo progresses, but the cable remains stationary, so as not to impede its speed. As the source of electric power is in the station, there is no limit beyond that imposed by the size of the cable and electric motor to the power which may be transmitted. The active explosive agent is contained in the submerged torpedo case, and in advance of the bow of the float. It, therefore, is the first portion to come in contact with the hull of a ship. The instant it touches the hull the motion of the craft will be arrested, and the electric instruments on shore will at once testify to such arrest of its course by the increased mechanical strain put upon the motor, which would at once affect the current. Finally the raking bow connection, which is seen in the illustrations, enables it to give under obstacles. This manœuvre has been subjected to a severe test, and the action of the torpedo in this way has been found to be very perfect.

As it was exhibited on Tuesday, it was worked from a shore station as shown. The torpedo was lowered in the water and the current turned on from the switchboard. At once the craft started into action, and at a rapidly increasing rate of speed ran out into the stream. Before it stopped it had completed its course of about a mile. Under complete control of the operator on shore, it emerged from the station, and describing a long and circuitous route in the water, returned nearly to its starting point. The mile of distance was completed in about three minutes, indicating the attainment of a very high rate of speed. When in full action the hull became nearly buried, while quite a wave was thrown from the rapidly advancing bow. In some observations it has been noted that the boat went so fast as to run away from the wave it generated. All through its course triangulation observations were taken at exact intervals, in order to determine its speed. These were in charge of the corps of engineers attached to Willets Point.

The torpedo is built in four sections, which can be taken apart or assembled in 15 minutes; none of the parts weighs more than 500 pounds. The motor at full speed can absorb over 30 horse-power available for propulsion. A speed of 22 miles an hour has been obtained by it. The charge of 250 to 500 lb. of high explosive is to be exploded electrically by reversing the current. The steering is also done electrically through the agency of a polarised relay.

Its operation from a shore station is limited in extent by the length of the connecting cable. In the large torpedoes this will be two miles. In operation from a war ship, it is proposed to run two or more boats along a parallel course with the ship and close to it, receiving their motive power from the ship's electric plant. Here, as the ship and torpedoes will all progress alike, and as the electric plant on board can supply power for an indefinite period, the ship and torpedoes can keep company for almost any number of miles. When the enemy is approached the course of the ship can be arrested or its speed can be slackened, and the torpedo sent ahead or to either side at high speed, in order to destroy the enemy. For fort use a special form of casemate with conning tower and other necessary features have been planned by the company. There is little question that a number of these torpedoes could do much to defend New York harbour, at the end of the East River, between Willets Point and Fort Schuyler, and at the Narrows, from entrance by hostile vessels.

THE ELECTRIC RESISTANCE OF GAS IN MAGNETIC FIELDS.

MY primary investigations with the action of magnetic fields upon Geissler tubes, the results of which I had the honour to place before the Academy, at the sitting of the 12th May, 1890, had yet, writes M. A. Witz (*Comptes Rendus*), to be completed; in fact, when the effects produced by varying the intensity of the field, and the position of the tube in relation to the field's lines of force had been studied, it still remained to determine the influence which a modification of the gas pressure within the tube would exercise.

My experiments were made with the aid of a glass cylinder, 2 cms. in diameter, fitted with taps, and as well adapted for compression of gas as for rarefication; the discharge took place between two electrodes, the cones of which were aluminium. With mercury pressure, 0 cm. 6, I obtained a violet tinted discharge; at 230 cm. the result was a spark, warm, brilliant, and sustained, in the form of a flash of fire between the points; and between these two pressures the appearances were a combination of spark and discharge. Now the action of the field, as presented to the eye, varies under these different conditions; the discharge is subject to deviation in obedience to the electrodynamic laws—the spark is not; consequently, when the pressure is slight, the action should be considerable; when with a high pressure it would be *nil*.

We have now to verify the exactness of these inferences, and the following are the results obtained :—

Outside the Field.

Pressure.	Current.	Difference of potential.
cm.	milliampères.	volts.
0 607	5·86	976
32·446	4·66	2,815
74·610	2·79	4,669
76·020	3·50	5,544
114·310	2·33	8,058
115·51	2·16	8,731
230·1	1·42	12,028

In a Field of 7,200 *Units.*

Current.	Difference of potential.
milliampères.	volts.
3·91	9,787
2·75	5,857
2·04	4,719
2·05	6,919
1·44	8,097
1·27	9,487
0·74	12,539

With the slight pressure 0 cm. 6, the difference in potential was ten times greater; whereas at 3 kg. pressure the variation was, so to speak, *nil*. From this I feel justified in concluding that it is only upon the electric discharge that the fields have any influence at all.

This, which with the Geissler tube is so considerable, must then be a peculiarity of the constitution of this tube and of the rarefied condition of the gas which it encloses, since it is not to be produced with free gases unconfined.

This should result in a previous indication for the analysis of the complex phenomena observable in the Geissler tubes. The similarity between the effects produced with a magnet and by the approach of a metal conductor (nay, by approaching the finger even) leads me to a fresh explanation of these phenomena. The similarity is striking, judged by one example. Thus a tube enclosing silicic fluoride gave the following results :—

Outside the Field.

Current.	Difference of potential.
1·50 milliampères.	2,434 volts.

In proximity with a mass of Iron.

Current.	Difference of potential.
1·16 milliampères.	3,185 volts.

In a field of 11,570 *Units.*

Current.	Difference of potential.
0·99 milliampères.	5,730 volts.

It is true the effects varied with the nature of the gas, the form of the tube, pressure, &c., but they were almost always remarked in connection with tubes of sensitive condition. The phenomenon was sufficiently general to allow of the action of the magnets being attributed to a varying in the electric capacity of the Geissler tubes. These tubes must constitute, therefore, genuine condensers, and their illumination should be the result of an oscillatory discharge of a nature similar to that of a Leyden jar, the period, T, of which is the function of the jar's capacity, C, and of the coefficient, L, of the conductor's self-induction, the resistance of which is assumed to be slight, since $T = \pi T = \pi \sqrt{C L}$. A varying of the capacity, C, would, consequently have the effect of modifying the vibratory condition of the gas, and be the occasion of the differences observable in the luminous phenomena of intense magnetic fields.

Lincoln and Electric Lighting.—The Town Council has refused to grant consent to any electric company wishing to supply the light.

ELECTROLYTIC THEORIES.*

By Prof. G. F. FITZGERALD, F.R.S.

ELECTROLYSIS has been explained on two different theories by Grotthüs and Clausius. As generally received they differ. Grotthüs's theory, as generally given, assumes that the molecules in an electrolyte are both polarised and moved by the electric forces within the liquid. This seems so far untenable that it would appear that double the electric force would double both the polarisation and the motion of the molecules, and so should produce four times the electrolysis. The objection, however, assumes that we know the causes resisting the motion, and with proper, and not very improbable assumptions as to the resistance to motion depending on it and on the polarisation, a linear relation between current and electromotive force, *i.e.*, obedience to Ohm's law, seems possible. A modification of Grotthüs's hypothesis in the direction of Clausius's is, however, possible. Suppose that when polarised the molecules *drew one another apart* at a rate proportional to the polarisation. This at once makes the relation between electric force and the decomposition a linear one, and so satisfies Ohm's law in the case of small currents. It also so far agrees with Clausius's hypothesis that it explains electrolysis and double decomposition as properties of the same kind. The molecules in a liquid will occasionally be arranged by accident in the proper polarised condition in a closed circuit for drawing one another apart; and if the circuit includes molecules of different kinds, there will result double decomposition. There seem to be very serious difficulties in supposing that uncombined atoms are for any finite time free in the liquid; and the supposition that it is a particular arrangement that is required before exchanges take place, and that with this arrangement exchanges take place of their own accord, seems to explain electrolysis and double decomposition without supposing free atoms to exist within the liquid. I have not assumed Prof. Armstrong's suggestion that the proper arrangement for double decomposition is a double molecule; but it seems a likely hypothesis, and one that should be investigated from the chemical rather than the physical side.

There are some other phenomena that have been explained upon the supposition that free atoms are gadding about in a liquid. Such are the lowering of the boiling and freezing points by solution of salts, and their effect on osmotic pressure. If dissociated atoms are going about in a liquid as in a gas, it seems impossible but that they must diffuse at different rates; and that this is not observed seems conclusive against the hypothesis, no matter what else the hypothesis may explain. Consider solution simply. Why does chloride of sodium dissolve in water? There must be some strong affinity between the two of a chemical or semi-chemical nature to break up the cohesion of the crystal; and it seems reasonable to assume that this same affinity keeps the molecules of NaCl moving about among the water molecules, so that they diffuse about. Now, if the forces drawing them about be independent of the nature of the molecule, most of the phenomena explained by gaseous laws are explained. Pressure of a gas depends, at any temperature, on the number of molecules, and not on their kind. This is Avogadro's law, by which molecular weights are calculated; and if the forces drawing a molecule about in a liquid are independent of the kind of molecule, the very same law of pressure would hold, the pressure forward of molecules of different kinds would depend on their number only, and in the same way as Avogadro's law would enable molecular weights to be calculated. In this connection it is well to state that some bodies may, nevertheless, be much better able to produce pressure than others, because of their being more easily polarised, *i.e.*, turned into an effective direction. A molecule which could be easily turned into an effective direction would be about twice as effective as a molecule which went about in a higgledy-piggledy way; and one would consequently expect electrolytes to produce more, nearly double, the osmotic pressure that other bodies did. As to the changes of boiling and freezing points, they seem explicable by exactly the same hyyothesis. The reduction of vapour pressure by molecular affinity of dissolved salt would depend only on the number of molecules of salt if all salts have the same molecular affinity for water; and the same would apply to the change in freezing point. Hence all these phenomena are explained without assuming free atoms and they are all explained by what can hardly avoid being a *vera causa*, namely, whatever affinities they are that cause solution, which latter is an unexplained phenomenon on the dissociation hypothesis. That it is reasonable to think that the forces keeping the molecules of salt moving about in the water are independent of the nature of the salt, appears from various considerations. In the first place, these forces are in all probability due to the residual affinities of the non-metallic elements. These same forces are probably the cause of crystallisation. These are old suggestions. That these residual affinities should be nearly the same for different combinations does not seem at all unlikely.

If a rather shaky argument in favour of its likelihood on mechanical grounds is desired, the following may deserve attention. Suppose a molecule of NaCl, for instance, at rest, or nearly so, in a crystal. Subject it to this affinity. Its velocity, after it has gone a distance, s, will be given by some such relation as $f s = \frac{1}{2} m v^2$. Now, for the sake of temperature equilibrium, with molecules of somewhat similar structure, $\frac{1}{2} m v^2$ must be the same in all. It seems likely that, at least approximately, the kinetic energy of motion is proportional to the total energy, and that this is the same for each molecular group; if so, the kinetic energy must be approximately the same for different groups. Now, with very dilute solutions s must be nearly the same for different molecules, and if so we get that for temperature equilibrium f must be independent of the nature of the molecule. How this equalisation of f for different kinds of molecules comes about may be as follows. Molecules in a liquid move about among one another, but are well within the sphere of one another's attraction, as is evidenced by superficial tension and by the tension to which a liquid can be subject. A very small change in the distance apart of the molecules means, however, a very great change in the forces between them, as otherwise they would be extensible and compressible like gases. It seems likely, then, that when a salt dissolves in a liquid it requires for temperature equilibrium that the distances of the molecules should change by the very small amount required in order that f may become the same for all substances. This very minute change in distance would not sensibly affect s.

Electrical Indicator of Explosive Gases.—An apparatus which indicates with safety the accumulation of explosive gases in the atmosphere of rooms is of great importance in many trades, and especially for use in mining operations and in the transport of coal by ships. M. Eduard Stern, of Cologne, has brought out such an apparatus. It consists of an external porous clay cylinder which contains a thin metal membrane capable of upward movement. Just above the membrane is a contact screw. When explosive gases begin to accumulate, they pass through the porous cylinder and gradually raise the membrane until it comes into contact with the screw. This completes an electric circuit and sets in operation a set of electric bells. The contact screw is very sensitive and may be adjusted to any degree, according to local circumstances. The apparatus is also applicable as a fire alarm and may be fitted in any convenient spot.

---

* Communicated by the Secretaries of the Electrolysis Committee of the British Association.

THE DYNAMO AS A MOTOR.

THE easy convertibility of a generator into an efficient motor was demonstrated lately in a very satisfactory manner at the Manningham Silk Mills of Messrs. Lister & Co., Limited, Bradford. During the recent overhauling of one of the main engines, which worked the machines in the batting, shearing and finishing departments, it was found that repairs had to be made which would take up so much time that unless substituted power could be obtained these important departments would be stopped, and a number of hands would be idle. As no ordinary or ready means were available for this object it was suggested by the electrician to the firm, Mr. Edwin Preece, that the dynamo used for the lighting of this department should be tried as a motor in place of the engine under repair. Permission having been granted for this trial, the electrician, assisted by Messrs. Andrews and Preece, Limited, Borough Mills, Bradford, quickly made the necessary arrangements, and the dynamo was very shortly at work driving the shafting.

In an article which we published on June 20th, describing the installation at the Manningham Mills, it was pointed out that one portion of the mills was lighted by a "Preece" 500 ampère dynamo, driven by an independent Robey engine, whilst the other portion of the mill was lighted by a similar dynamo, driven by a clutch arrangement from the main engine of the mill (which was the one broken down). The two systems of lighting were, as explained, connected together by mains governed at each switchboard by a double plug switch, with only one pair of plugs, in order to avoid confusion; but under the altered circumstances, it was necessary to connect up the plug switch at each board, consequently a second pair of plugs had to be obtained; the arrangement was then complete, after the ropes from the flywheel had been disconnected from the main driving pulley in the shaft. The Robey engine was started, driving the dynamo attached to it and generating a current which was transmitted to the second dynamo by means of the conducting wires and the double connection of the switchboards, the second dynamo then—its brushes being reversed—became a motor, and being clutched on to the main shafting by means of its own counter-shaft, produced sufficient power to work the various machines required in the department.

The whole arrangement was completed in about an hour after the decision had been arrived at, and the machinery was started without the slightest hitch whatever. The current passing into the motor varied from 250 to 500 ampères, according to the different loads, at a potential of 115 volts; it was kept running for about 36 hours without one single stop or the slightest interruption whatever. The remarkable self-regulation and regularity of speed under different loads, was an agreeable surprise to the principals of the firm, who were so well satisfied with the new arrangements that in all probability a further development of electricity as a motor may be decided upon. This is, we believe, one of the few instances where a dynamo has been utilised to take the place of the steam motor which usually drove it, and thus enable the operations of the factory to be carried on with but the slight delay due to the necessary alterations in connection. The whole operation reflects credit on those engaged, and demonstrates the extraordinary value of the dynamo-electric machine.

KING, BROWN AND CO. v. THE ANGLO-AMERICAN BRUSH CORPORATION.

By S. ALFRED VARLEY.

FORMAL notice of appeal to the House of Lords in the above case has, I am informed, been given. The judgment lately delivered in the Court of Appeal not only confirms and strengthens that previously given in the Court of Sessions, but is so clear and unambiguous that I cannot think it possible that the directors of the Brush Corporation will have the support of their shareholders, generally, in spending more money over litigation.

In November, 1887, the suit of Brush *v.* Crompton was compromised, judgment in favour of the plaintiffs being agreed to, and licences accepted, and the position of the Brush Corporation in respect to compound winding was consequently very much strengthened. At this stage I intervened, and, with a view to arousing the electrical industry to resist the claims so far successfully asserted, I tried the case, journalistically, through the medium of the columns of the ELECTRICAL REVIEW, in four consecutive articles which appeared in December, 1887. The following passage appears in the first article:—

"In my opinion, the electric light industry has so far allowed the Anglo-American Brush Corporation to simply walk over the course, and it seems to me the industry has acted most short-sightedly in doing so. It requires no prescience to foresee, that after the trade has acknowledged the claims asserted by the Brush Corporation, by submitting to pay royalties, that the next step will be to apply for a prolongation of the patent on the ground that this *valuable* invention, due to the *genius* of Brush, has yielded no returns commensurate with the expenditure incurred in developing it. And who shall blame them for making such an application, seeing that in the circumstances I have mentioned, it would most probably be successful?"

I also analysed and called attention to the very unsatisfactory character of the scientific evidence, and the publication of my articles resulted in Messrs. King, Brown & Co. resisting the Brush Corporation, and this firm, instead of waiting the convenience of the Anglo-Brush Corporation, took the initiative by themselves, commencing proceedings in the Scotch Courts, and after being successful in the preliminary skirmishes, on the advice of the Court, they took proceedings for the reduction of the Brush patent.

The case came on for hearing in the Court of Sessions, Edinburgh, in November, 1888, the Court deciding in favour of the pursuers, with expenses, and this judgment has been sustained on appeal.

In my opinion it is simply lamentable, and indicates a sad condition on the part of scientific professors, to see a physicist so distinguished as Sir William Thomson professing to be puzzled and not able to understand a plain simple description, which the judges had no difficulty whatever in comprehending, and doing so after *practical* evidence had been given before the Court by more than one unscientific mechanic and apprentice that they had experienced no difficulty in understanding the description given in my specification. The Court declared the description of compound winding given by Brush to be the same as that given in my specification, the only difference being that I had described it more simply. Now, Sir William Thomson and his brother professors did their best to persuade the Court that the description given in Brush's specification, in which compound winding was described as a "teazer," was as plain and understandable, as they declared mine to be incomprehensible.

Now, although there is scarcely any likelihood that the judgment given in the Scotch Courts will be reversed by the House of Lords, nevertheless, until it is disposed of, it will have a baneful influence on the industry, and therefore I would suggest that the industry should unite and draw up a pamphlet, giving a plain statement of the facts; that they should issue this pamphlet in their corporate capacity to the members of the Chamber of Commerce, to the members of the engineering and scientific societies, and also request the press to notice the matter contained in the pamphlet.

In this way, at a very small pecuniary cost, moral pressure would be brought to bear on the directors of the Brush Corporation, and the shareholders would, in all probability, oppose further useless waste of money on litigation.

REVIEWS.

Dictionnaire d'Electricité et de Magnétisme. Premier Fascicule, A—Electrolecteur. Avec 284 figures. Par JULIEN LEFEVRE, Professeur à l'Ecole des Sciences de Nantes; avec la Collaboration d'Ingenieurs et d'Electriciens. Paris: J. B. Baillière et Fils, 19, Rue Hautefeuille.

It is intended that this dictionary shall appear in four parts, the last to be issued before the end of the year. The complete set will form a volume of 1,100 pages, containing about 1,000 figures. Judging from the part now before us, the whole work, when complete, will be a very valuable addition to electrical literature, and will constantly be used for reference purposes. The value of the compilation would have been considerably increased had it been made more universal; thus, for example, under the first heading, viz., "Abonnement," we have full information given with reference to the subscriptions to the telephone exchanges in France, but nothing with reference to those in other countries. Of course, to have included the latter would have increased the size of the work, and it is probably this consideration which has limited its scope. The compilers have wisely made their descriptions fairly full, *i.e.*, have not sacrificed clearness to brevity; thus we have accumulators dealt with in nine closely printed pages, with several illustrations. The information given appears generally to be fairly accurate; here and there, however, we come across somewhat strange statements, as, for instance, when we are informed that to measure the insulation resistance of a cable the latter is placed in *acidulated* water; also, that submarine cables are wound upon great *drums* on the ships. Electric lighting is dealt with in 40 pages—Messrs. Woodhouse and Rawson's work coming in for a fair share of notice; considering the almost endless sources of information there are on this subject, and the consequent extreme difficulty of condensing the available matter, the selection made is very judicious and the scope wide. Altogether, the work creates a very favourable impression, although it is distinctly written (possibly not intentionally) from a French point of view.

Journal of the Institution of Electrical Engineers, No. 88. London: E. & F. N. Spon, 125, Strand.

This number contains the following:—Paper on "The Treatment, Regulation, and Control of Electric Supply by the Legislature and the Board of Trade," by Major P. Cardew, with discussions on the same.—Communication from Dr. Oliver Lodge in reference to damage to cables by lightning; this latter has reference to the suggestion that condensers and cables are never damaged by lightning, and professes to be testimony from Dr. A. Muirhead and Mr. Gott to the contrary; the testimony does not appear to be very conclusive as regards cables. The usual abstracts, &c., complete the number.

Crystal Palace Engineering School.—On Saturday last the certificates to successful students of the Crystal Palace School of Practical Engineering were distributed by Sir James N. Douglass, F.R.S., Engineer-in-Chief to the Corporation of the Trinity House. He referred in his address to the increasing attention given of late years in this country to technical education as a means of enabling young engineers to enter on equal terms the competition with other nations. He thought the best thing a young man could learn was that competition would follow him through life. An Englishman ought never to be afraid of competition, and if he did his work faithfully was sure of success in any part of the world. The work of the students was exhibited in the shops and offices, and as usual was very creditable, including some interesting dynamo work in the electrical section.

NOTES.

Electric Light in Churches.—Arrangements for the complete lighting of the Church of St. Jude, South Kensington, by electricity, have just been concluded between the Vicar and Churchwardens, and the House-to-House Electric Light Supply Company, Limited, of Richmond Road, West Brompton. The installation is to consist of 275 incandescent lamps of 8 candle-power, the existing gas fittings being utilised in nearly every instance for the distribution of the light. The nave, for example, will be lighted by 144 lamps; 12 lamps to each of 12 coronas. The chancel will absorb 66 lamps, 30 on two standards in front of the altar, and 36 on four standards for the choir stalls; 18 lamps will be distributed on brackets round the galleries, and 28 for the lighting of the aisles. There will be 5 lamps within and about the organ, one of them being a portable lamp, to facilitate tuning operations, &c., without the danger involved in the use of matches and of exposed gas burners. The remaining lamps go for the lighting of the vestry, gallery stairs, &c., &c. The whole installation will be completed, connections made with the company's mains, and the current supplied within about a month.

Electric Lighting at Portsmouth.—The new Portsmouth Town Hall, which was declared open with befitting ceremony by the Prince and Princess of Wales on Saturday, has been temporarily illuminated at night by the electric light. The Admiralty kindly placed the services of Mr. Lane, dockyard electrician, at the disposal of the corporation, and that official and his staff brought to bear on the magnificent building three search lights of 25,000 C.P. each. The general effect was heightened by some interesting experiments in colour.

Southampton and the Electric Light.—At a meeting of the Town Council it was resolved to refuse the offer of the local electric light company, which wanted £750 for the licence obtained from the Board of Trade.

Electric Light at Ilkley.—It is said that there is a probability of the town authorities adopting the electric light.

Electric Lighting at Sydney.—Electric light plant has been erected in the Hotel Metropole for supplying 700 incandescent lamps. The installation was designed throughout by Drake and Gorham, and the work was carried out at Sydney to their instructions and specification by Mr. J. A. Arnot, of the Union Electric Company, of Australia. The plant is considered one of the finest and most successful hitherto erected in the colonies.

The Tory Island Signal Station.—The Londonderry *Sentinel* of the 7th inst., states that the opening of the signal station on Tory Island has been arranged to take place on the 26th inst., when the opening ceremony will be performed by her Grace the Duchess of Abercorn, who will send the first message to the Queen. The event will be made the occasion of an excursion to the island, and the steamer *Thistle*, of the Laird Line, has been secured for the trip. On arriving off Tory, the *Thistle* will sail round the island, enabling the visitors to obtain a good view of it, and off the Greenport a floating despatch-case, containing the Duchess's telegram, and those of any members of the party who may be desirous of investing a shilling for a telegram from the furthest point in the Atlantic within the area of the United Kingdom, will be dropped overboard, picked up by a boat from the island, and taken to the signal station, whence the messages will be despatched to their destinations in all parts of the kingdom. This will be the first practical experiment of Mr. M'Neill's scheme for communication with passing Atlantic liners which Lloyd's Committee have adopted.

Is it Visual Telegraphy?—In the *Evening Standard* of the 9th inst. we read the following:—"Telegrams from the Azores state that the continued drought is causing great damage to the crops, and creating financial and commercial difficulties, in consequence of which the inhabitants are protesting against the fresh taxes recently imposed." We fail to see how a telegram can come through a cable which does not yet exist, although so frequently proposed.

Appointment.—We are informed that our note last week to the effect that Mr. A. R. Bennett had been appointed engineer-in-chief to the Mutual Telephone Company was, at least, premature. Mr. Bennett has resigned his post of general manager in Scotland to the National Telephone Company, but, so far, has not entered into an engagement elsewhere.

New Primary Battery.—A company is in process of formation to manufacture a new primary battery for telephonic purposes.

The E.P.S. Monopoly.—It has for some time past been rumoured in electrical circles that the monopoly held for this type of storage battery could be broken down by the expenditure of £10,000 in the law courts, and it is probable that an attempt will, at no distant date, be made to effect this object.

Electrical Engineering in Melbourne.—Owing to the repeated request of students, a class has been formed at the Working Men's College, Melbourne, in electrical engineering. Over 90 students have enrolled for the first term, and Mr. A. J. Arnot, M.I.E E., late engineer in charge of the Grosvenor lighting station, has been appointed instructor.

Cost of Arc Lamp Trimming.—The manager of an American firm has introduced the system of paying lamp trimmers on a piece-work basis. Previously they received $2 a day; now they are able, being paid 2 cents per lamp, to make as much as $65 a month. Each man, on the new basis, looks after, on an average, 100 lamps a day.

An Arc Cigar Lighter.—An interesting novelty has been made by an American firm for cigar lighting. It consists of a small arc lamp, the mechanism of which is hidden. By pressing a button the arc is started, and the mere application of the cigar lights it uniformly. The lamp consumes only half an ampère at an E.M.F. of 50 volts. The cost, it is claimed, does not exceed 8d. a month. It can be readily transformed into a table lamp by the addition of an ornamental shade.

The Work of Street Cars.—Recently compiled figures show that there are in America and Canada nearly 9,000 miles of street car track. Out of this number about 6,000 miles are worked by horses, and 2,000 by electricity. This is a wonderful percentage when we consider that electric cars have only been working about five years.

Gas Engine Wanted.—The clerk of the Cockermouth Local Board requires an estimate for furnishing and fixing a gas engine for raising water. Particulars on application to Messrs. Pickering and Crompton, civil engineers, Whitehaven.

Edinburgh Exhibition Awards.—It has been decided by the Executive Council of the exhibition that no awards will be made in the electrical section.

City and Guilds Institute.—On referring to the advertisement, page 12 of supplement, our readers will find the programme for the session 1890-91. The entrance examinations will take place on September 22nd to 24th for the Central Institution, and on September 30th for the day department of the Technical College, Finsbury. Full particulars may be obtained at the office of the Institute.

Electricity in Fulham.—The vestry has refused the application of Mr. S. Morse, on behalf of the Chelsea Electricity Supply Company, for permission to run electrical trams through Fulham.

Correction.—In the portion of the Institution paper, "The Working Efficiency of Secondary Cells," published last week, the following corrections should be made: Page 167, first col., 5 lines from the bottom, for 0·045 ohm, read 0·0045 ohm; second col., 2nd line, for 0·11, read 0·011 ohm; 3 lines from bottom, 0·038, read 0·0038 ohm; page 168, 2nd line, first column, 0·09, read 0·009 ohm.

German Telegraph Employés and Uniforms.—The German Emperor has now, by a recent warrant, given a special uniform to the ladies employed by the Administration of Posts, Telegraphs, and Telephones. Henceforth these ladies will have to wear a knitted blue jersey with orange yellow collar—similar to the officers of German dragoons—with metal buttons and ornaments. The Berlinese who have seen the innovation, find the effect charming; but the unhappy young women, it appears, do not feel any goodwill for Herr von Stephan, the Postal Secretary of State, for the new attractions which he has procured for them. Probably, as everything German is just now so popular in England, from the *Pickelhaube* downwards, we shall soon have our telegraph *employés* put into "uniform."

Foreign Trade.—The exports during July of telegraphic wires and apparatus connected therewith, amounted to £56,575, as compared with £32,909 in July last year, and £21,571 in July, 1888. For the seven months ended 31st July, the figures were £778,287 in 1890, £609,365 in 1889, and £265,784 in 1888. The value of the imports of copper ore for the month was £62,702 this year, £87,530 in 1889, and £135,692 in 1888; regulus and precipitate, £347,775 this year, £312,492 in 1889, and £404,495 in 1888; while unwrought and part wrought copper amounted to £347,775, £312,492, and £404,495 respectively. The imports of caoutchouc were £159,209, £131,883, and £117,363, and of gutta-percha £43,657, £47,531, and £7,623.

Tramway in Lombardy.—Some time ago a project for an electric tramway between Lodi and Chignole was brought forward, but owing to the high initial expenditure required, the scheme was left in abeyance. Mr. Pietro Zoncada has revived the project and proposes to reduce the amount of capital necessary so that the tramway may be built. A company is shortly to be formed to construct the line which will be the second in Italy.

Woodhouse and Rawson United, Limited.—The contract department of the above firm held its annual excursion on Saturday, August 2nd, when a most enjoyable day was spent, Brighton being the scene of revelry. After dinner, everyone was pleased to hear, from the chairman, of the rapid strides the department had made during the past year and musical honours were accorded to the healths of Messrs. Reginald J. Jones and B. Thomas, their energetic engineers.

Deeper and Deeper Still.—A subterranean Eiffel Tower for London is the discovery of a Florentine journal, according to which, a company has been formed in London to construct a huge shaft bored to the depth of 1,500 feet, with lifts, platforms, and restaurants at various depths, and geological collections showing the points of the various strata traversed. It will be lighted by electricity, and will have "a scientific as well as a merely recreative purpose."

Re The International Cable Company, Limited.—Mr. Justice Stirling has fixed Thursday, the 21st. inst., at 12 o'clock, at his Chambers, Royal Courts, Strand, W.C., as the time and place for the appointment of an official liquidator of the company.

Dissolution of Partnership.—The partnership between Messrs. Jno. Shaw, Thomas Connolly and William Speakman (Shaw & Connolly), electrical engineers at the Newton Electrical Engineering Works, Newton Heath, Manchester, has been dissolved by mutual consent from the 5th inst.

Electric Belts.—It is almost a hopeless job to try and educate the daily press to such a point that they will decline to insert the advertisements of the purveyors of electric belts and similar appliances, but better things are to be expected of a journal which professes to be of a quasi-scientific nature. Yet, week by week, a contemporary inserts the announcements that Harness's belt is "a safeguard against rheumatic and nervous affections, liver and kidney diseases, and ladies' ailments," and possibly, also, corns, the potato disease, cholera morbus, scarlet fever, housemaid's knee, and all the ills that flesh is heir to. We should be glad if some explanation of the circumstances were given, and to learn whether our contemporary is prepared to assert a belief in the statements put forward.

The Edison Phonographic Toy and Automaton Company, Limited.—The following has been issued by the secretary to applicants for shares:—"I am instructed by the Board to inform you that questions having arisen as to the ownership of certain of the patent rights proposed to be acquired by this company, the directors have decided that at present it is undesirable to make any allotment of shares. Kindly, therefore, send in the banker's receipt for the amount paid by you on application, and I will forward you cheque for the amount paid by you per return of post."

Peculiar Accident in Edinburgh.—On Monday night a newsboy accidentally fell from the top of an electric lamp-post at the foot of the Waverley Steps, and was picked up insensible. He was taken to the Royal Infirmary, where it was found that his skull was so severely fractured that his recovery is considered rather doubtful. By some of those who witnessed the accident it is supposed that on climbing to the top of the post—a height of about 14 feet—the boy came in contact with the electric current, and was really flung to the ground by the severity of the shock. This, at all events, is clear, that his fall broke the wire or cable, and left the entire Waverley Station in darkness, so far as the electric light was concerned. Men had to be summoned to light the station gas-lamps.

Electric Traction.—A minute of the Tramways Committee of the Glasgow Town Council states that a letter had been received from the Electric Tramcar Syndicate, Limited, bringing under the notice of the committee their system of electric traction. Consideration of the matter has been postponed.

The Gaulard Monument.—The monument recently erected at Lanzo, Italy, to M. Gaulard, by the Societa Elettricita Italiano, of Milan, was inaugurated on the 3rd of the current month.

Fareham Electric Lighting Poles.—The Grand Jury at Winchester Assizes returned a true bill against the Fareham Electric Light Company, the contractors, and three other persons, charging them with committing a nuisance in erecting poles. On behalf of the prosecution, application was made to Mr. Justice Mathew, in accordance with the usual practice in such cases, for an order that the case should stand over to the next Assizes, to give the defendants an opportunity of pleading to the indictment.

Telegraphy in San Salvador.—A Consular report states that there is now a total of 89 telegraph offices in San Salvador, with about 1,467 miles of wire. The telegraph service, in general, is satisfactory. The rate for an inland message, or one to any of the four sister republics, consisting of five words, and not including the address and name of sender, costs 1 real 12½ c., or about 4¼d.

Telephones in San Salvador.—The same authority announces that the telephone service of San Salvador has a wire mileage to the extent of some eighty leagues, and when the lines in construction are completed, it is computed that there will then be wire employed extending to 110 leagues. Private telephones in use number 111, whilst in the Government service 48 are employed.

Cable Testing.—There has just come to hand a letter on this subject from Mr. H. Cuthbert Hall, which will receive the attention it deserves in our next issue.

A Real Electrical Locomotive.—Says the Victorian *Electrical and Telegraphic Journal*:—"The following graphic description of a locomotive charged to a high tension with electricity has been brought before our notice:—'When the engine commenced to blow off, *the engine* seemed to be charged with electricity to such an extent that it was as much as I could do to hold the lever, and if ever I put my hand on the iron bucket and touched the lever with the other hand, the sparks seemed to come out of the tips of my fingers. It would even give a shock *through the clothes* when in contact with the lever wheel.' This last statement is, we think, slightly overdrawn, and further particulars of the thinness and texture of the interposing garments would be acceptable. The phenomenon is not novel, but any accounts from eye-witnesses would doubtless prove interesting to our readers, who may try and solve its probable cause."

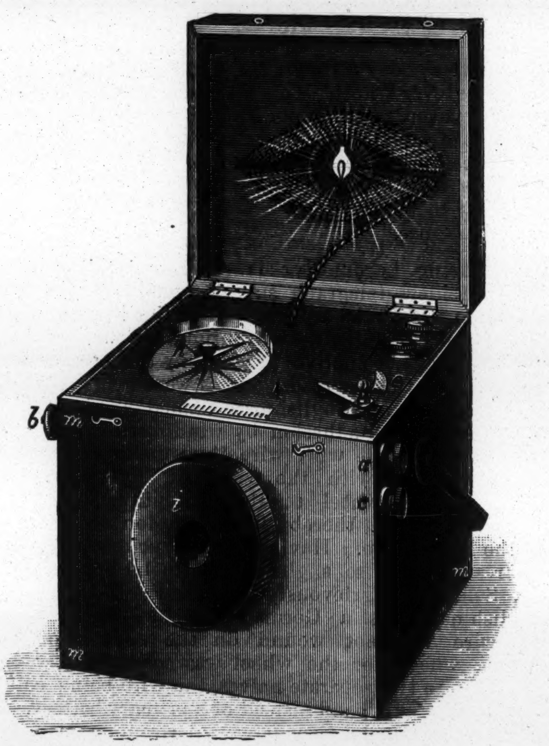
Increasing Locomotive Traction.—On June 16th, Mr. C. Selden, telegraph superintendent of the Balt. and Ohio R.R., read a paper before the Railway Telegraph Superintendents' Convention, Niagara Falls, on "Increasing Locomotive Traction by the use of Electricity." In this we read "efforts were made some 15 years ago, by an Englishman named Wederman, to overcome the non-adhesion by winding the spokes of the driving wheels with wire, thus making a magnet of the wheel, with the view of, by magnetism, attracting the wheel to the rail, thus increasing the friction, and thereby the adhesion to the rail of the locomotive. Having but a primary battery, the results were so slight as not to be appreciable." Mr. Selden is grievously in error; the so-called Englishman was a German named Werdermann; the wire was not wound on the spokes of the driving wheel, for the wheel was made hollow and divided into two separate halves, the wire being coiled inside on the axle; and instead of a primary battery, Mr. Werdermann used a very powerful Gramme machine. The result, however, of his experiments showed that a pull of half a ton would detach the rail from the wheel, so the idea of using magnetism to increase adhesion, to any useful extent, was abandoned.

American Promptness.—*Apropos* of the great fire, involving a loss of $125,000, which took place in the Western Union Building, New York, on Friday, July 18th, *Electric Power* remarks:—"The astonishing recuperative power of American business men was never better shown than in this fire. In less than a week from the time of the fire, everything was again in perfect running order, and the immense business of the company was handled with accuracy and promptness."

China and Japan Telegraphs.—The Hong-Kong Chamber of Commerce, and other Chambers in China and Japan, have presented a petition to the Queen in opposition to the ratification of the pending Convention between the Chinese Government and the Eastern Telegraph Company and the Eastern Extension, Australasia and China Telegraph Company, Limited. The petition complains that the Convention has for its object the monopoly of telegraph business between China and the outer world, and that the continuance of present extreme rates for the transmission of messages must prove detrimental to commercial and other interests generally.

The Compound Winding Case.—The Anglo-American Brush Corporation has intimated that it will appeal to the House of Lords. What good can come out of this is better known to the Corporation than to us.

The Central Station Companion.—A combination instrument, called "The Central Station Companion," has just been invented by Mr. H. J. Dowsing and Mr. A. A. Day, the leading features of which are its compact form and simple arrangement, qualities which are greatly to be recommended. The "Central Station Companion," as usually made, is of the following dimensions, viz.: 6 inches by 8 inches by 4 inches, and contains:—1. An ordinary detector or galvanometer. 2. A Wheatstone bridge to measure from ·05 to 50 ohms. 3. A standard ohm. 4. A variable resistance or rheostat. 5. A set of four small accumulators for giving a light when testing. 6. Necessary switches, connections, contacts, &c. If required, a 10-ohm standard coil can be inserted to increase the readings tenfold. An essential feature of "The Central Station Companion" is its simplicity. Any workman can use it, and as there are no loose keys, complicated coils, or calculations to make, mistakes cannot occur. To use as a detector, the ends of the circuit must be connected to the two end terminals, and the key pressed, when the battery and galvanometer are put into circuit. To use the Wheatstone bridge, all that has to be done is to insert the resistance to be measured between two of the terminals and turn the knob in front (which inserts more or less resistance), while pressing keys until there is no deflection in the galvanometer. Then read the actual resistance from the scale. As above stated, there are no calculations required, and the resistance in ohms is read off direct. With a little adaptation the instrument can be used as a potentiometer, or for comparison of potentials, by Poggendorff's method. The incandescent lamp is a useful addition to the testing set, and makes the instrument useful as a portable lamp, and the battery can readily be charged at any of the stations where low tension continuous currents are in use. If, however, it is preferred, a special form of Leclanché can be fitted which will run a small lamp for a few minutes, giving ample time to make intermittent tests. It is an important point in connection with this testing apparatus that it can be made to measure higher or lower resistances as required for special purposes. The scales can be given a large range of reading at any desired point, so that accuracy may be assured. Perhaps the greatest argument in favour of the "Companion," beyond its compactness and portability, is its low price. One of the ordinary size can be obtained at about half the cost of the cheapest form of a Wheatstone bridge.



NEW COMPANY REGISTERED.

Atlas Engine Company, Limited.—Capital £12,000, in £1 shares. Objects: To acquire as a going concern the Atlas Engine Company, at Poole, Dorset, and to carry on the business of engineers, electricians, electric light contractors, dynamo manufacturers, &c. Signatories (with 1 share each): E. Sparshott West Field, Peter Gotto, both of Poole; C. Lamb Gotto, 54, Oxford Street; J. Foster Penny, 8, Trafalgar Square, Brompton; A. Brunel Armitage, 5, New Broad Street; H. G. Gotto, 54, Oxford Street; J. Haynes, 92, Tufnell Park Road. In lieu of a board of directors, the management is vested in the two first subscribers, who are appointed managing directors, and will each be entitled to a monthly salary of £12 for the first three years, subsequently to be increased as the company in general meeting may determine. Qualification, 500 shares. Registered 9th inst. by Walter Deverell and Co., 5, New Square, Lincoln's Inn.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electric Traction Company, Limited.—At an extraordinary general meeting of this company, held at 35, New Broad Street, on the 1st ult., it was resolved to wind up voluntarily, Mr. G. A. Redford being appointed liquidator, with authority to dispose of the company's property to the General Electric Power and Traction Company, Limited, as agreed to by a contract of 23rd May, 1890, between this company of the first part, Moritz Immisch & Co. of the second part, and the General Electric Power and Traction Company, Limited, of the third part. The resolutions were confirmed on the 23rd ult., and were duly filed on the 6th inst.

Mutual Telephone Company, Limited.—The nominal capital of this company has been increased to £250,000 in £10 shares, beyond the registered capital of £100,000, in accordance with the resolution passed in general meeting on the 21st ult. The notification to the Registrar of Joint Stock Companies of such increase was filed on the 7th inst.

Byng Telephone Company, Limited.—At an extraordinary general meeting of this company, held at St. Nicholas Chambers, Newcastle-on-Tyne, on the 2nd ult., it was resolved to wind up voluntarily, and that Mr. John Philip Spencer, of 48, Collingwood Street, Newcastle-on-Tyne, be appointed liquidator. The resolution was confirmed on the 18th ult., and was duly filed on the 5th inst.

The annual return of the company, made up to the 30th April, was filed on the 5th May. The nominal capital is £5,000 in £10 shares; 207 shares have been taken up, and £8 per share has been called and paid thereon, the paid-up capital thus being £1,656.

Electric Meter Company, Limited.—The statutory return of this company, made up to the 1st inst., was filed on the 2nd inst. The nominal capital is £50,000 in £10 shares; 2,007 shares are taken up, 2,000 of which are considered as fully paid. Upon the remaining 7 shares the full amount has been called, but remains unpaid. Registered office, 25, College Hill.

Durand Electric Petroleum Gas Engine Manufacturing Company, Limited.—The statutory return of this company, made up to the 29th ult., was filed on the 2nd inst. The nominal capital is £100,000, in £5 shares. 1,907 shares are taken up, and of these, 1,900 are considered as fully paid. Upon seven shares the full amount has been called, but remains unpaid. Registered office, 175, Strand.

Crompton and Company, Limited.—The annual return of this company, made up to the 4th inst., was filed on the 8th inst. The nominal capital is £140,000, divided into 20,000 preference, and 8,000 ordinary shares of £5 each, the whole of which are taken up. Upon 20,000 shares the full amount has been called, the calls paid amounting to £99,980, and unpaid to £20. The remaining 8,000 are considered to be fully paid.

Elmore's Wire Manufacturing Company, Limited.—The statutory return of this company, made up to the 28th ult., was filed on the 7th inst. The nominal capital is £300,020, divided into 150,000 ordinary and 10 founders' shares of £2 each. The shares are 64,333 ordinary and 10 founders'. Upon the former £1 per share has been called, and upon the latter the full amount. The calls paid amount to £55,681 5s., and unpaid to £8,671 15s. Registered office, 20, Bucklersbury, E.C.

CITY NOTES, REPORTS, MEETINGS, &c.

Maxim-Weston Electric Company, Limited.

AN extraordinary general meeting of shareholders, of whom some fifty were present, was held at Winchester House on Thursday last, when the following resolution was moved by the Chairman, Mr. J. B. Gooding, seconded by Mr. Couchman:—That it has been proved to the satisfaction of the meeting that the company cannot by reason of its liabilities continue its business, and that it is advisable to wind up the same; and, accordingly, that the company be wound up voluntarily.

The Chairman said, in his opinion, the present board of directors was not in any way responsible for the disastrous state of the company's affairs. The company had been started under very unfavourable conditions. It started with a nominal capital of some forty or fifty thousand pounds, of which only fourteen thousand was subscribed. They were acquainted with the manner in which it had been spent; the company was now practically without resources and the directors felt compelled to ask them to pass the resolution before them. A meeting had been held to ascertain the feeling of the shareholders with regard to subscribing any more money to keep the company going. Although some £1,500 pounds had been promised by way of debentures, that was not nearly sufficient to admit of the concern being carried on. Before submitting the resolution he read a few figures connected with the working of the business during the past six months. The company had on January 1st, roughly, £5,000 in hand; it had since received on account of shares £30; for transfer fees £5; bank interest on deposit £13 10s.; a loan of £50; on accounts collected and for work done £1,200, making a total of £1,303 4s. 5d., or a gross amount of £5,700. The company had paid for directors' fees £148; salaries £467; wages £336; rates and taxes and rent £220; gas account £106; travelling expenses £28 4s. 4d.; petty cash £125; trade accounts £2,255; liquidation costs and other expenses incidental to legal proceedings £970; making a total of £4,658. That left a balance of £1,031, of which £1,000 lay in the bank to the credit of the liquidators of the old company. The company's present liabilities amounted to £256; cash in hand and accounts to be collected to £74, and as assets to be received from St. Margaret's Mansions—but whether recoverable remained to be seen—£300. So that although the company's affairs were in a very bad state it would go to the wall without taking anybody there, *i.e.*, it would discharge its liabilities. The directors had received one or two very encouraging letters from shareholders, but the result of the last meeting had been so unsatisfactory that they had thought fit to draw up the resolution which was now before the meeting. In reply to a shareholder, he further stated that the action against Mr. Watt was still pending; the solicitor thought it more than likely to be completed within the present year, after the vacations. With regard to the position of the company with reference to the liquidators of the old company, the property of the present company had not yet been assigned to it by the old liquidators. The present position was this: any assets realised by the sale of the company's property, would, the directors had been informed by the solicitor, be required by the liquidators of the old company to be deposited at the bank pending Mr. Watt's action. He, the chairman, could not altogether reconcile that with the statements and actions of the old liquidators in the past. The directors were told in the first instance that £1,000 would cover everything, next that £2,000 was required, and now they were told that a liquidator of the new company selling any of the company's effects would be unable to touch one farthing of the proceeds. So the company was practically at the mercy of the liquidators of the old company, and he, the speaker, could not congratulate the shareholders on occupying that position. He for one did not feel at all comfortable.

A Shareholder: Who is responsible for that state of affairs.

The Chairman: I should say the solicitors of the present company, because they did not require the old liquidators to assign.

The Solicitor: That is not the fact. This company has everything it is entitled to. What is there that it has not had beyond some four or five thousand pounds that can be realised by selling the company's effects? The chairman altogether fails to recognise that the interests of the old liquidators and of the present company are identical. Anything they may recover will be for this company's benefit; but very naturally they say "We are making ourselves personally responsible for costs and liabilities, and therefore the new company must indemnify us in case we lose." Is not that right and proper?

Several Shareholders: Yes.

The Chairman: I certainly think the solicitors should, in the interest of the present shareholders, have seen that the property was legally assigned.

A Shareholder: Surely when the new company was formed, its relation to the liquidators of the old company was defined by some contract or agreement, and surely the directors of the new company would have seen that that contract was so framed as not to place them entirely at the mercy of the old liquidators.

The Chairman: Some months ago I called attention to the fact that the liquidators declined to convey the property of the company. I now believe that this was through an oversight on their part. But I say in the interests of this company the solicitors should have seen that the property was actually assigned. Your liquidators cannot touch one farthing of the assets as matters stand. The identity of interest spoken of by the solicitor is only apparent. We have ceased to require the services of the old liquidators, and, speaking as a shareholder, I am not satisfied to let them have their own way. With one exception, I have no confidence in them at all.

The same Shareholder: When the new company was formed there must have been as part of the reconstruction scheme, a contract that the liquidators should on some terms or other convey the property to the new company.

The Solicitor: There was a contract to convey subject to the liquidators' claim to be indemnified for any responsibility incurred by them. Why should they have taken upon themselves these liabilities for the benefit of the new company without an indemnity. I repeat their interests and yours are identical, and I am astonished at what has fallen from the chairman. It is not true that I have not called the attention of this company to the fact that, as yet, there has been no assignment.

The same Shareholder: If there was no proper contract of a kind to prevent the new company from being placed entirely at the mercy of the old liquidators, some one ought to be held responsible. If you pass this resolution you should be careful whom you appoint as liquidator.

The Chairman: the solicitor says this contract to assign exists under certain conditions. We say we have fulfilled those conditions. Now the solicitor tells us that, no matter what may be sold, the liquidators will not allow one penny to go out until Watt's action is decided. Therefore, pending that decision, we have nothing. The solicitor of the company should have insisted on the property of the old company being conveyed to us. In reply to a shareholder, the chairman said that they would have a larger sum to pay for legal expenses than the sum mentioned above, before the affair was concluded. He also said the company had had to abandon its contracts owing to want of ready money. The directors might have obtained credit, but had not seen their way to incur fresh liabilities. The company had just sufficient to pay its present debts.

Mr. Marks: I am surprised to hear the chairman say that the old liquidators will not consent to see a sixpence worth of the company's property parted with unless the funds pass through their hands. The liquidators were called upon by the shareholders to prosecute the action against Mr. Watt. It makes no difference to the company whether the property has or has not been assigned. The liquidators of the old company made an agreement with the new company, by which the now company undertook to indemnify the liquidators for any costs incurred in the action against Watt, and the assets of the old company, and also of the new company, were made liable for any sums paid by the liquidators in the action. The property has not been assigned simply because there was no need; but had they done so, the liquidators would have taken care that the new company deposited such a sum as would cover any costs incurred in the action. As one of them, I have no objection to the assignment. (To the solicitor): You would be satisfied to advise the liquidators that they would be perfectly secure if £1,000 were placed to their credit?

The solicitor assented.

The Chairman: At the last meeting of the board, the solicitor said that no matter what the present company or its liquidators might sell, the old liquidators would not allow any of the money to be spent.

The Solicitor: What I said was, that the liquidators would naturally require the liquidators of this company to indemnify them in the action agaist Watt.

Mr. Marks: We are prepared at this moment to execute the assignment subject to something further being placed to our credit.

Mr. Hodgson, a director: The dynamos we possess are very good of their kind, but an electrical company to succeed must progress, instead of like their late managers being content to consider themselves the best electrical company in the world and allowing some of the patents to lapse. The company has still a very fine plant, and with proper prudence we might yet undertake small installations, only the money we have obtained has been so insufficient as to oblige us to go into liquidation. The dynamos are worth a thousand or two.

The Chairman: You will receive not one farthing if this company goes into liquidation. To carry on the works you require a capital of £100,000 at least. By confining your operations to lighting and private installations there is, I think, still a legitimate business to be done with a small capital.

A Shareholder: Whatever liabilities this company may incur we have sufficient assets to liquidate them?

The Chairman: Most certainly.

Mr. Marks: Your liabilities amount to about £300.

The Chairman: Yes.

Mr. Marks: And you estimate the value of the plant at your works at about £7,000 as a going concern?

The Chairman: Yes.

Mr. Marks: Don't you think the sense of the meeting ought to be taken as to reconstruction? No doubt there is a gigantic field of work open to competition for a considerable time.

A Shareholder: We have let everything go to the wall.

The Chairman: I am willing to admit that as much has not been done as ought to have been. But we have been employing travellers; and we have erected a private installation in Ireland which is giving satisfaction and is a splendid advertisement. But we have no capital to go on with.

A Shareholder: I do not see that it has been satisfactorily proved that we cannot continue our business. You say you have no liabilities beyond £300 except Watt's action, and you say you have £7,000 worth of plant.

The Chairman: I cannot conceal the fact that each one of the directors has already lent money to enable the company to pay its weekly wages. It is true we have been repaid but in a very haphazard manner. No doubt in the coming winter an enormous amount of lighting will be done.

A Shareholder: Is it not true that some important contracts have been lost by us simply because it was expected the company would come to grief? The Aquarium for instance?

The Chairman: The Aquarium is still open. The step which is embodied in the resolution now before you has not been taken hurriedly or rashly. We called a private meeting of shareholders but they never came.

A Shareholder: I have heard a rumour that if the meeting does not come to any resolution to-day, a petition for winding up the company will be presented to the Court to-morrow.

Mr. Hodgson: If we had £3,000 we could do a lot of work and I would personally see that the money was not wasted.

The Chairman: I have always said that the works were a clog upon our action, having no capital.

Mr. Marks: I beg to move an amendment that this meeting adjourn for a fortnight, and that in the meantime the board invite a certain number of the largest shareholders to confer as to a basis for a reconstruction scheme. I know as a fact the company has lost a good many lighting contracts owing to its not being in a position to take them in hand, the Royal Military Exhibition at Chelsea, the Waterloo Panorama, for instance. But you have laid foundations for securing many such contracts in the future, and I cannot help thinking that if the shareholders are invited to find funds for a solid reconstruction scheme, you would yet have a future before you.

The Chairman: Gentlemen who support the amendment should hand over their cheques for a sufficient sum to meet our present liabilities, viz., £300, or we shall be served with writs, and petitions will be filed.

A Shareholder: I cannot see how you are going to induce shareholders to find fresh money. £14,000 has already been frittered away at the rate of £1,000 a month and no trading has been done for it. I am prepared to support a scheme for reconstruction if Mr. Marks will consent to become liquidator, associating himself with Messrs. Hodgson and Couchman.

The resolution to voluntarily wind up the company was then put and carried.

An attempt was made, and failed, to bring in an outsider, Mr. Newson Smith, as liquidator, and Messrs. Marks and Hodgson were ultimately appointed. The proceedings then terminated.

The City and South London Railway Company.

THE directors' report was laid before the shareholders in meeting at Winchester House, on the 12th inst. at noon, Mr. J. Grey-Mott presiding.

The Chairman said they would recollect that at the time of their last meeting the Stockwell Tunnel was incomplete, but was being steadily driven through a strata of wet gravel. That had now been completed without any mishap, and since the whole of the tunnels were now finished, the shareholders might accord their best thanks to the engineers and contractors for the exceptionally successful way in which they had carried out a work of exceptional difficulty. He believed there was hardly a record anywhere of so long a tunnel being driven with so little loss of life or accident. The completion of the tunnel had been followed by the completion of the permanent way through it; the electrical main cable had also been completed in both tunnels, as also the service of the conductor, by which electricity was conveyed to the locomotives. The lifts had taken a much longer time to construct than had been anticipated by Sir William Armstrong's firm, and this had necessarily caused some delay in the final completion of many of the works connected with the stations and approaches. They were now, however, making very satisfactory progress. The underground stations were practically all completed, and those above ground were very nearly so. Arrangements for lighting them electrically with light taken from the ordinary conductors used for lighting the town had been temporarily abandoned, it having been found that taking the light in that way would involve certain fluctuations, and also it would consume a considerable amount of power which the directors were unwilling for the moment to take from the general propelling power. They had, therefore, thought best to make provisional arrangements for lighting the stations with gas. These and also the signalling arrangements were nearly complete. At the depôt there were three hydraulic engines for compressing the water by which the lifts would be worked; they had been tested, as also had been the pipes and accumulators, and were in good working order. There were three very powerful vertical engines for driving the electrical current dynamos; one of them had already been worked with one dynamo with very satisfactory results, and the second vertical engine and dynamo would, he believed, be worked for the first time that day. The third, which was held in reserve, was also completed, or nearly so, and he believed that in the course of the next two or three weeks the whole of the electrical plant would be in working order. The engine and carriage sheds had been roofed in, and were in other respects ready for use. So that the shareholders would see that the great bulk of the work had been completed. A great deal of the rolling stock was ready; some engines were on the spot, and, he was happy to say, the engines and carriages had been run the whole length of the line with electrical power at a greater speed than was actually required for the service of the line. They had therefore no cause to doubt that in a very short time the railway would be open, and, as regards the working, they had every reason, judging by the experimental trials which had taken place, to anticipate that there would be no difficulty on that score. The directors were now making arrangements for a working staff, and, of course, being perfectly new, it would be necessary that the staff should be given an opportunity to become acquainted with their duties, and therefore the line would be worked for a short time before being thrown open to the public, and, in fact, the engine-drivers were already practising their duties. Thus the risk of failure afterwards would be avoided. He would be very sorry to commit himself to a date after the delay which had already taken place, and he would therefore only express the hope that by the end of next month the line would be in a condition to be opened. The Bill for extending it to Clapham had received the royal assent and the name of the company had been changed to that of the City and South London Railway Company. The directors proposed at a special meeting, following the practice of all railway companies, to create the capital authorised by the Act, but they had no intention to make the extension until the line should be in proper working order. Referring to the Central London Railway Bill, he said that it had somewhat departed from the principles upon which they of the City and South of London had been working. Its proposal for a junction between the two lines would have been practically unworkable, and had been ultimately withdrawn. The Bill had now, after long enquiry, been thrown out, and he, the Chairman, was inclined to think the decision of the Lords a wise one, because the Bill had not been conceived upon the lines of the City and South London Company, nor, in his opinion, upon lines which would have made it a profitable undertaking. Possibly it would be reintroduced in an improved form, and, in that case the City and South London Company would be happy to co-operate in any workable scheme. In the meantime, many points would have to be considered in regard to any proposed extension by which the company might obtain a more complete control of the city traffic than it already possessed. That might be done at comparatively small cost. Up to the present the company had only spent some £660,000, which was very close to the original estimate. Upon that policy the future earnings and dividends of their company, and of other city underground railways, must depend, because when they exceeded beyond a certain sum, it became practically impossible for a line of railway to earn a really good dividend whatever might be the traffic; it being all essential that the capital cost should be kept within a defined and known limit. They saw what a very poor return the Metropolitan and Metropolitan District Railways gave for their enormous traffic. It was a warning which ought never to be forgotten in any extensions they might make. He begged to move the adoption of the report.

Mr. Hanbury seconded, and the resolution was agreed to unanimously.

At an extraordinary meeting held immediately afterwards, the Chairman moved to convert the share capital into stock to facilitate its transfer. He added that it was not proposed to carry it into effect immediately, or before the share capital had been more completely issued. As a rule all railway companies found it more convenient to have the capital in the form of consolidated stock. The resolution was seconded by Mr. Hanbury and agreed to, and the proceedings terminated with a vote of thanks to the chair.

The Chili Telephone Company, Limited.

THE directors' report (printed in our issue of August 1st), and the accounts for the half-year ended March 31st, were presented at the annual general meeting of the shareholders at Winchester House, noon, August 8th, Colonel Raynsford Jackson presiding.

The Chairman said the shareholders, who had doubtless read in the prospectus that the directors anticipated a dividend from the very commencement of 6 per cent., would be inclined to ask how it happened that the report only mentioned one of 5 per cent. In the first place, when the prospectus was issued, the rate of exchange was 26d. per dollar, whereas it was now fallen to 24d., and the average rate of exchange during the eleven months over which the accounts extended had been 25¼d. Had it continued all through at 26d., the company's earnings would have been between £900 and £1,000 more, and the dividend anticipated would have been realised. The directors had had still another difficulty to contend with, one which had deprived the company's general manager in Chili of the control of the company's affairs up to the middle of the last month of its financial year. It happened in this way: There was an unregistered body of shareholders in the West Coast Telephone Company residing in Chili, who, through not having had their shares registered, had been left in ignorance of the affairs of the West Coast Company until they suddenly learned that their property had been sold. They imagined that the sale price was over and above the amount of the West Coast Company's liabilities, and, therefore, that they were entitled to be paid a very large sum of money. They were entirely mistaken, because the West Coast Company's system had been purchased on the understanding that that company met its liabilities, and therefore all that these shareholders were interested in was the surplus left to the company after meeting its liabilities, which proved to be a very small sum indeed as compared to their anticipations. They thought to protect their interests by preventing, pending satisfaction of their claims, the legal registration of the transfer of the West Coast Company's system to the Chili Company, by means of an injunction obtained in the local court. The consequence was that the management of the Chili Telephone Company remained in the hands of the vending company until the middle of April, when arrangements were made for the appointment by the West Coast Company of the Chili Company's manager as their manager also. Thus the company's manager had now a recognised position which enabled him to look after the company's affairs, introduce economy, improve the service, and otherwise develop and promote the company's interests. In spite of these difficulties the company's progress had been satisfactory. An increase had taken place during the year of 33 per cent. in the number of subscribers, and in the gross revenue of the company; and he thought a still larger increase might be anticipated for the present year, not merely because the difficulties above-mentioned no longer existed, but also because the company had purchased for £36,000 the National Telephone Company of Chili, the only rival it had in the country. That company had possessed important local influence. It was formerly controlled by natives who enjoyed considerable power and influence in Santiago and Valparaiso, and who had shown themselves very hostile to the Chili Telephone Company, and had co-operated with the dissentient shareholders of the West Coast Company in doing the company considerable damage. Having bought off the opposition of the National Telephone Company of Chili, the company had also weakened the position of the dissentient shareholders; and he thought he might now hold out an assured prospect of its anticipations being realised, and of the shareholders possessing a property of real intrinsic and sound value. He moved the adoption of the report and accounts.

Mr. T. Greenwood seconded, and the motion was carried unanimously.

The Chairman also moved to declare a dividend of 2s. 6d. per share, as recommended, payable at the company's bankers on and after the 9th inst., free of income tax.

The Hon. F. E. Allsopp seconded, and the motion was carried unanimously.

The Chairman, in moving the re-election of Mr. T. Greenwood as director, spoke in warm terms of the services of that gentlemen in connection with the negotiations referred to above. The motion was seconded by Mr. Venables, and agreed to.

The Hon. F. E. Allsopp was also re-elected a director, Mr. T. A. Welton was re-appointed auditor, and with a vote of thanks to the chair the proceedings terminated.

Liverpool Overhead Railway Company.

THE fourth half-yearly meeting of the shareholders of this company was held recently in Liverpool. Sir Wm. B. Forwood, the chairman, presided. The report of the directors stated that the progress in the construction of the railway during the past half-year had not been as great as they had looked for. Difficulties of a technical character had arisen, but these had been surmounted, and already several complete spans were in position, and the directors had every reason to believe that henceforward the erection will proceed with rapidity. The expenses of administration had been defrayed out of interest on capital paid up, and the balance of revenue account had increased to £1,129 0s. 5d. The general balance-sheet, made up to June 30th last, showed on the debit side the following items:—Balance at credit of capital account, £105,223 1s. 7d.; balance at credit of revenue account, £1,129 0s. 5d.; amount retained as security for completion of contract No. 1, £1,295 7s. 9d; owing to sundry creditors, £547 19s. 1d.; total, £108,195 8s. 10d. The amounts on the credit side were £5,427 17s. 5d., deposit £102,767 11s. 5d.; total, £108,195 8s. 10d.

The Chairman explained the position of the undertaking. The works were not actually commenced till October last, and the progress made had not been so rapid as the contractors had led them to expect. This did not arise out of any difficulty in the construction of the overhead railway itself, that being a very simple matter indeed; but it arose from the automatic machinery which the contractors employed with the view to economy not being in the perfect working order which he had believed. He was glad to say, however, that all the difficulties connected therewith had since been overcome, and the machinery for turning out and drilling the plates was now working perfectly, and the work was being proceeded with as quickly as might be expected. They were now turning out nearly two spans per day, and, if they continued at this rate, the line would be completed in 12 or 13 months. Difficulties were, however, always incidental to works where machinery was employed, and therefore they must not be too sanguine that the work would be finished in the time named. It would be seen from the photographs exhibited in the meeting room that the railway, when completed, would not be an unsightly object. Indeed, comparing it with what he had seen of American overhead railways, this would be the best looking overhead railway he had seen. As to the equipment of the line, they had not yet taken any steps, but, as previously indicated to the shareholders, electricity had been adopted as the propelling power. The progress in this as a motor was such that they had been advised by their engineer to postpone deciding upon the precise system until the last moment. Referring to the £108,195 to their credit in the general balance-sheet, he was glad to say that it was gaining interest, and they would also be glad to see that after paying the expenses of administration for the past half-year, the balance to their credit on revenue account had increased to £1,129 0s. 5d. The Mersey Docks and Harbour Board had agreed to spend a further large sum at the north end in addition to what they had expended at the south. This would considerably increase the amount of traffic upon the railway. From everything he could see they would have a large traffic, and he looked forward to the future with very great expectation. He moved the adoption of the report and balance-sheet.

Mr. Richard Hobson seconded the motion, which was carried unanimously.

A vote of thanks to the chairman terminated the proceedings.

Birmingham Tramway Company.—At the annual meeting of the Birmingham Tramway Company, on Wednesday, the chairman (Mr. Smith) expressed the hope that they had seen an end of the fuel boom. They were paying 17s. per ton this year for what they paid 10s. 5d. for in 1887. Nevertheless, the year's operations had been very prosperous. The opening of the electric line in the Bristol Road had been demonstrated to be a scientific and mechanical success. What now remained was to see whether it could be worked with economy. Steam traction cost 3d. per mile; he believed the cost of electric traction would not be far from that sum.

Sheffield Telephone Exchange and Electric Light Company, Limited.—It has been resolved to wind up the company voluntarily in view of a reconstruction. Messrs. T. G. Shuttleworth, accountant, and W. Johnson, the secretary of the company, both of Sheffield, are the liquidators, with power to consent to the registration of a new company, to be named "The Sheffield Telephone Exchange and Electric Light Company, Limited," and to make an agreement with such new company.

The European Electric Welding Company.—A further payment of £20,000 has been made in Boston by the English purchasers of the company, making £70,000 paid in cash. Payment of the balance, £40,000 and 33⅓ per cent. of the stock to be issued by the London company, is guaranteed by the City of London Contract Company, the cash to be paid about November 1st.

The Schanschieff Electric Battery Syndicate, Limited.—Creditors are further notified to send names and addresses and particulars of debts and claims to Richard Rabbidge, the liquidator, 32, Poultry, London, E.C., on or before the 19th instant, or to be excluded from any distribution prior to such claims.

Elmore's Wire Manufacturing Company, Limited.—Application has been made to the Stock Exchange Committee to appoint a settling day, and grant a quotation in respect of ordinary shares.

The Electric Construction Corporation, Limited.—Application has been made to the Stock Exchange Committee to allow the company's shares to be quoted on the official list.

TRAFFIC RECEIPTS

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ending August 8th, were £4,863.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending August 8th, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,761.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (August 7.)	Closing Quotation. (August 15).	Business done during week ending August 15, 1890.	
					Highest.	Lowest.
£ 250,000	African Direct Telegraph, Ltd., 4 p. c. Deb. Regd. and to Bearer	100	97 —100	97 —100		
1,549,160	Anglo-American Telegraph, Limited	Stock	49½— 50½xd	49½— 50½	49⅞	49⅝
2,725,420	Do. do. 6 p. c. Preferred	Stock	85 — 86 xd	85 — 86	86	85
2,725,420	Do. do. Deferred	Stock	13½— 14	13¾— 14¼	14	13½
130,000	Brazilian Submarine Telegraph, Limited	10	11½— 12	11¾— 12¼	12⅞	11 13/16
99,000	Do. do. 5 p. c. Bonds...	100	100 —102 xd	100 —102	101⅛	...
75,000	Do. do. 5 p. c. 2nd Series, repayable June, 1906	100	103 —107	103 —107		
63,416	Brush Electric Engineering Ordinary, Nos. 1 to 63,416... ...	3	1½— 2	1½— 2	1¾	...
63,416	Do. do. Preference, Nos. 1 to 63,416 ...	2	1½— 2	1½— 2	1⅝	...
$7,216,000	Commercial Cable, Capital Stock	$100	103 —105	103 —105	103¾	...
224,850	Consolidated Telephone Construction and Maintenance, Ltd. ...	14/-	9/16— 11/16	9/16— 11/16	½	...
20,000	Crompton & Co., Limited, 7 p. c. Pref. Shares, Nos. 1 to 20,000	Stock	5¼— 5¾xd	5¼— 5¾		
16,000	Cuba Telegraph, Limited	10	12¾— 13¼	12½— 13½xd		
6,000	Do. do. 10 p. c. Preference	10	17 — 18	16½— 17½xd	17¾	17⅜
12,931	Direct Spanish Telegraph, Limited ... (£4 only paid)	5	3½— 4	3½— 4	3⅞	3⅝
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10		
60,710	Direct United States Cable, Limited, 1877	20	10⅛— 10⅜xd	10⅛— 10⅜	10¼	10⅛
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	13⅞— 14⅛xd	13⅞— 14⅛	14¼	13⅞
70,000	Do. 6 p. c. Preference	10	15 — 15½xd	15 — 15½		
200,000	Do. 5 p. c. Debs. (1879 issue), repay. Aug., 1899	100	106 —109 xd	106 —109	108¼	...
1,200,000	Do. 4 p. c. Mortgage Debenture Stock	Stock	106 —109	106 —109		
250,000	Eastern Extension, Australasia and China Telegraph, Limited	10	14 — 14¼	14 — 14¼	14¼	14 1/16
320,000	Do. 6 p. c. Debentures, repay. February, 1891	100	100 —102 xd	100 —102	100½	...
446,100	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. ...	100	103 —106	103 —106	103	...
12,500	Do. 5 p. c. Debentures, 1890, redeem. ann. drawings ...	100	103 —106	103 —106		
367,900	Eastern and South African Tel., Ltd., 5 p. c. Mort. Deb., 1900...	100	100 —103	100 —103		
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	4¾— 5¼	4¾— 5¼		
46,700	Elmore's Patent Copper Depositing, Ltd., Nos. 23,001 to 70,000	2	4¼— 4¾xd	5¼— 5¾	5 15/16	4 11/16
19,700	Fowler-Waring Cables, Nos. 301 to 20,000 ...(£3 only paid)	5	2 — 2½	2 — 2½		
180,227	Globe Telegraph and Trust, Limited	10	8⅞— 9⅛	8⅞— 9⅛	9 1/16	8⅞
180,042	Do. do. 6 p. c. Preference	10	14⅞— 15⅛	14⅞— 15⅛	15⅛	14⅞
150,000	Great Northern Tel. Company of Copenhagen	10	15¾— 16¼	15½— 16	15⅞	15¾
40,000	Do. do. 5 p. c. Debs. (issue of 1881) ...	100	100 —103	100 —103		
250,000	Do. do. do. (issue of 1883) ...	100	106 —109	106 —109		
9,334	Greenwood and Batley, Ltd., Ordinary, Nos. 4,667 to 14,000 ...	10	12 — 13	12 — 13		
5,334	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	11½— 12½	11½— 12½		
41,600	India-Rubber, Gutta-Percha and Telegraph Works, Limited ...	10	18½— 19½	18½— 19½		
200,000	Do. do. 4½ p. c. Deb., 1896...	100	102 —104	102 —104		
17,000	Indo-European Telegraph, Limited...	25	37 — 39	37 — 39	38¾	38¼
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7		
100,000	Do. do. do. 6 p. c. Debentures ...	100	107 —110	107 —110		
49,900	*Metropolitan Electric Supply, Limited, Nos. 6,101 to 50,000 ...	10	4 — 4½	4 — 4½	4¾	4¼
436,700	National Telephone, Limited, Nos. 1 to 436,700	5	4¾— 5	4⅞— 5⅛	5 1/16	4⅞
15,000	Do. 6 p. c. Cum. 1st Preference	10	12¼— 12¾	12¼— 12¾		
15,000	Do. 6 p. c. Cum. 2nd Preference (£8 only paid)	10	10 — 10½	10 — 10½	10½	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11/- only paid)	1	¼— ⅜	¼— ⅜		
9,000	Reuter's, Limited	8	7¾— 8¼	7¾— 8¼		
209,750	South of England Telephone, Ltd., Ordinary, Nos. 1 to 2,000, 2,501 to 3,500, 93,251 to 300,000	1	¼— ½xd	¼— ½		
20,000	Do. 6 p. c. Cum. Pref., Nos. 1 to 20,000 (£3½ only paid)	5	2½— 3 xd	2½— 3		
3,381	Submarine Cables Trust	Cert.	113 —117	113 —117		
78,949	Swan United Electric Light, Limited ... (£3½ only paid)	5	5 — 5½	5 — 5½	5 3/16	5⅛
37,350	Telegraph Construction and Maintenance, Limited	12	42 — 44	42 — 44	43¼	...
150,000	Do. do. do. 5 p. c. Bonds, red. 1894	100	100 —102	100 —102		
55,000	United River Plate Telephone, Limited	5	4 — 4½xd	3½— 4½	4⅛	3¾
146,000	Do. do. 5 p. c. Debenture Stock... ...	Stock	90 — 94	90 — 94		
100,000	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...		
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	9 — 10	9 — 10		
300,000	Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	101½	...
30,000	West Coast of America Telegraph, Limited	10	5 — 6 xd	4 — 5		
150,000	Do. do. do. 8 p. c. Debs, repay. 1902 ...	100	106 —110	106 —110		
64,572	Western and Brazilian Telegraph, Limited	15	10 — 10½	10¾— 11¼	11	10¼
26,986	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 7	6½— 7	6 15/16	6 11/16
26,986	Do. do. do. 5 p. c. Deferred	7½	3¾— 4¼	4 — 4½	4⅜	4 3/16
200,000	Do. do. do. 6 p. c. Debentures "A," 1910...	100	103 —106 xd	103 —106		
250,000	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	101 —104 xd	101 —104		
88,321	West India and Panama Telegraph, Limited	10	2¼— 3	2¼— 3	2⅞	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11¼— 11¾	11¼— 11¾		
4,669	Do. do. do. 6 p. c. 2nd Preference ...	10	12½— 13½	13 — 14		
1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mort (Building) Bonds	$1,000	120 —125	120 —125		
179,300	Do. do. 6 p. c. Sterling Bonds	100	99 —101	99 —101		
42,853	*Westmstr. Elec. Sup. Corp., Ord., Nos. 101 to 42,953 (£2 only paid)	5	1¼— 1¾	1¼— 1¾		

* Subject to Founders Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7⅛—7⅜.—Electric Construction Corporation (£10 paid), 7¾—8¼ Elmore Copper Depositing Priorities, 5¾—6¼.—Elmore Wire, ¼ dis—par.—House-to-House Company (£5 paid), 5 —5½.—International Okonite, Ordinary of £10 (£4 paid), 3¾—4¼.—London Electric Supply Corporation, Ordinary (£5 paid), 1¾—2.—Manchester Edison and Swan Company, £9 (£1 paid), 11/- —13/-.

BANK RATE OF DISCOUNT.—5 per cent. (31st July, 1890).

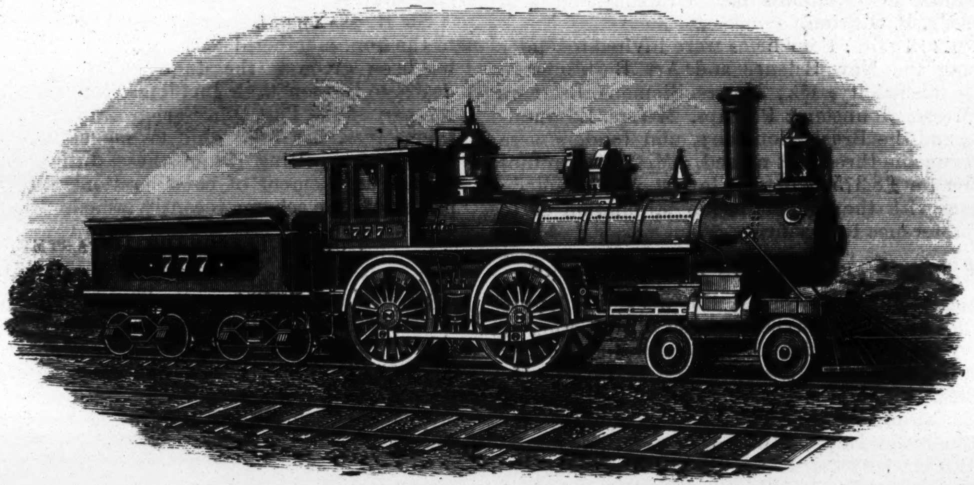
THE RIES ELECTRIC TRACTION-INCREASING SYSTEM.

WE have recently devoted considerable space to the discussion of the increased adhesive effect produced between driving wheels and rails and other metallic surfaces when traversed by an electric current under given conditions. Among the contributions upon this interesting subject, we (New York *Electrical Engineer*) have had the pleasure of describing in detail the important results obtained by Mr. Elias E. Ries, during a series of original investigations and experiments extending over a considerable period, in the direction of applying this method of increasing tractive adhesion to steam and electric railway locomotives.

It will be remembered that in this system of electrically increasing traction as developed and practiced by Mr. Ries, a low tension quantity current is made to flow through a local circuit of almost negligible resistance, of which circuit the driving wheels and that portion of the track rails immediately below and between them form the principal part. This current produces a slight local heating or incipient welding effect at the points of contact between the wheels and rails, which is practically instantaneous in its action, and brings about a decided increase in the coefficient of friction between the opposing metallic surfaces.

Practical interest in the subject has recently been awakened among railway men by the exhibition of working models of this invention at the annual meetings of the Association of Railway Telegraph Superintendents, and of the American Railway Master Mechanics Association, held at Niagara Falls, N.Y., and at Old Point Comfort, Va., resectively, on June 18th and 19th, 1890, at which the new method of increasing tractive adhesion met with considerable favour, the models exhibited showing an increase in traction due to the current of over 200 per cent. Preliminary tests of the invention, as applied to steam locomotives in regular service, have been very successful, and this, together with the favourable reports of experienced railroad officials who have investigated the system, has recently led to the organisation, in Baltimore, Md., of the Ries Electric Traction and Brake Company, with a capital stock of $2,000,000, for the purpose of further developing and introducing the same.

We are enabled this week to present to our readers, through the kindness of this company, a perspective view showing the general appearance of a steam passenger locomotive equipped with their electric traction-increasing apparatus, and we hope soon to be able to make public the results of the new series of test that we understand are now in progress on the Baltimore and Ohio Railroad.



Referring to our illustration, it will be seen that the traction-increasing current is generated by a small alternating current dynamo driven by a rotary engine supplied with steam from the locomotive boiler. The engine and dynamo are mounted upon a common base secured to the boiler in the position formerly occupied by the sand box. One or both pairs of driving wheels are electrically insulated from the body of the locomotive and from each other by the use of special insulation surrounding the driving box and side rod brasses. The insulation so far employed has proven itself fully capable of withstanding the exceptionally severe strain to which it is subjected, and tests made after several months of continuous service have led to its permanent adoption for this class of work.

Electrical connection with the two pairs of drivers is maintained by means of peculiarly constructed brushes bearing upon brass sleeves secured to the central portion of each driving axle. These brushes are connected, by means of heavy stranded copper conductors, with the source of low tension current, which in the case illustrated is a transformer (not shown) placed in proximity to the main driving axle. A type of machine is now about to be used, however, which generates directly the low tension quantity currents required. As the resistance of the traction-increasing circuit is practically constant under given track conditions, the flow of current is usually regulated by varying the electromotive force, which, on account of the low resistance of the circuit and multiple connection of the driving wheels, can be kept very low. The current density at the points of contact between the driving wheels and rails can be varied at will, according to the percentage of increased adhesion desired, the usual range being from 500 to 2,500 ampères.

It is proposed to use part of the current generated by the dynamo, either directly or indirectly, according to the type of machine employed, for the operation of electric locomotive and train brakes, electric headlight and train lighting, &c., in addition to its use for increasing traction. The dynamo is generally kept running at a slow rate of speed when not otherwise employed, and is so constructed as to respond promptly and automatically to any demand that may be made upon it within the limits of its capacity.

Experiments already made upon a large scale have shown that by this method it is possible to increase the tractive adhesion of locomotives fully 25 per cent., thus enabling them, with a saving of fuel, to haul a largely increased load, to mount heavier grades, and to descend the same under perfect control and without the skidding of wheels. Besides this, it will enable railroads to haul, with their present engines, much longer trains than they can now do, thus not only increasing the carrying capacity of the road, but saving largely the wear and tear upon tracks and bridges that the use of heavier engines for this purpose would entail. It will likewise enable both passenger and freight locomotives to make better speed and to maintain schedule time notwithstanding ordinary unfavourable conditions of the track due to the weather.

A recent report of a large railway shows that an increase of *one-fifth of one car* per train brought an increased revenue of over $50,000 in six months. It is needless to say, therefore, that if the claims made by the Ries Electric Traction and Brake Company for their traction-increasing system are even partially realised in practice—and the experiments already made by Mr. Ries go to indicate that these claims are entirely within the mark—the increased earnings to railroads from the use of this invention would be simply enormous, to say nothing of the operating and other advantages to both steam and electric railways that would result from its adoption.

PARLIAMENTARY NOTES.

THE DUBLIN SCIENCE AND ART BUILDINGS.

IN the House of Commons last Thursday night, in answer to Mr. P. O'Brien,

Mr. **JACKSON** said: Four firms were invited to tender for lighting the New Science and Art Buildings in Dublin by electricity, viz., Messrs. Siemens Brothers and Co., Messrs. Johnson & Phillips, Messrs. Edmundson & Co., and the Brush Company, and tenders were received from the three first named. Messrs. Edmundson's tender for £8,375, being the lowest, was accepted; the contract with them contains no stipulation as to giving a preference to any firm.

USE OF TELEGRAPHS BY THE FISHERY BOARD.

During the debate on Supply last week, Mr. **DUFF**, in the course of a speech, complained of the action of the Fishery Board in taking from the surplus herring brand fees £1,500 for the extension of telegraphs. He did not deny that the telegraphs were of great importance to the fishing community, but he contended that they were used for Imperial purposes.

The **LORD ADVOCATE** in his reply stated that the application of the money of the fund to telegraphs had been described as a grant in aid of the Imperial expenditure, but he would point out that it was not a correct way of describing it, because it was merely aid given to the fishing harbours for telegraphic purposes.

DIRECTORS' LIABILITY BILL.

In the House of Lords, on Friday night, Lord **HERSCHELL**, in moving the third reading of the Directors' Liability Bill, explained and vindicated the alterations made in the measure by the Standing Committee of their lordships' House, contending that, instead of weakening and maiming the Bill, as some critics had alleged, they only tended to render it more easily workable and effective. He, however, expressed his regret at the adoption in committee of the whole House of the Lord Chancellor's amendment in respect to responsibility for the statements of experts—a change which, he thought, involved considerable danger.

The Lord **CHANCELLOR** defended his action in regard to the Bill, asserting that his only object had been to make it, if possible, a reasonable and workable measure.

After some remarks from Lord **BRAMWELL**, the Bill was read a third time, and, having then undergone some verbal amendment, it was passed.

LIGHTHOUSE ILLUMINANTS.

In the House of Commons, last Friday, Mr. T. W. **RUSSELL** asked the President of the Board of Trade whether the committee of the Royal Society appointed to inquire into the report on lighthouse illuminants had sent in their report, and, if not, when it might be expected.

Sir M. **HICKS-BEACH**: I understand from the president of the Royal Society that the committee on this subject do not propose to have any further interviews, and that their report is partly drawn up, but it seems doubtful whether it will be finished before the prorogation.

THE LIGHTING OF THE HOUSE OF COMMONS.

Sir G. **CAMPBELL** asked the First Commissioner of Works if he would arrange before next session to put shaded electric lights in the roof of the House, so as to save members from the heat and glare of the gas in the long winter nights, and make the nearest possible approach to daylight.

Sir H. **MAXWELL** said the electric light was tried some time ago in the roof of the House, but the results were not satisfactory. The present gaslights were connected with the ventilation, and it would be inconvenient to dispense with them.

TELEGRAPH CLERKS.

Dr. **FARQUHARSON** asked the Postmaster-General whether any steps were being taken to redress the grievances complained of by the clerks of the Central Telegraph Office as to the extra hours without equitable remuneration for what are known as long and short duties.

Sir H. **MAXWELL** (on behalf of Mr. Raikes): In reply to the hon. member, I have to state that much attention has been given to the duties referred to, with every desire to lighten their incidence, but no one, either on the part of the Post Office or on the part of the officers themselves, has been able to suggest any practicable scheme for getting rid of these duties. This matter formed an element of consideration in improving the pay under the scheme recently issued.

DUBLIN TELEGRAPH DEPARTMENT.

In answer to Mr. MacNeill,

Sir H. J. **MAXWELL** said: The question of revising the salaries of the Dublin supervising staff will be considered as early as possible in connection with similar questions elsewhere, but it is improbable that improvement, should improvement prove to be necessary, will take effect from a date anterior to that on which the authority of the Treasury is given.

THUNDERSTORMS.

A TYPICAL thunderstorm, writes Mr. H. A. Hazen in *Science*, is first seen as a dense, ragged cloud in the west, extending to a height of over a mile. The sky is entirely clear elsewhere, except sometimes covered by a light fleecy veil of cirrus. The cloud in the west rapidly enlarges, and completely covers the sky except a small portion to the east and south-east. The motion of these clouds is distinctly from the west and quite rapid, while the surface wind is from the south and quite gentle. This wind is blowing toward a general storm situated about 500 miles to the north-west, and has no connection at all with the thunderstorm, which is suddenly, interjected, as it were, upon the quiet air. Often there are seen two clouds in the south-west and north-west which seem to meet together and produce the storm, but more often the first appearance is that of a great cloud of dust borne upward about 300 feet, and advancing with great rapidity from the west (sometimes 80 miles per hour). Some of the clouds sprinkle a little rain as the dust-cloud advances, but this is very light. When the storm is very severe, a loud roar is heard like the continuous discharge of electricity, which produces a steady instead of intermittent thunder. During this time, lightning-flashes are seen and distant thunder heard. In a few moments, after the dust-cloud has approached nearer, and practically with it, the wind suddenly whirls to the west, and blows with great velocity (sometimes 80 miles per hour). Then, in a moment or two more, the lightning and thunder become very intense, and rain falls in torrents. Often the lightning's flash is the signal for a fresh downpour, allowing a few seconds for the fall of the rain from its height. This phenomenon has led to the view, now almost universally accepted, that there is a most intimate relation of cause and effect in this display of electricity and the subsequent rain. Under some circumstances, but invariably in connection with this heavy rain, there fall hail-stones variously measured from the size of a pea to that of hen's eggs, and even larger. In some cases, larger masses, even as great as an elephant, have been reported, but these are due to a mingling or freezing together of many stones in the air or after they reach the earth.

During the progress of a thunderstorm, and after its front has reached the observer, there is a remarkable cooling of the air. This cooling seems to arise from a downward current in the centre of the storm. It cannot be due to the onrush of a north-westerly wind, for that must come from a warm region, since the thunderstorm has been suddenly interjected into a region of warm southerly winds flowing for hundreds of miles toward the north. This cooling is often very great, and seems to indicate that the air in the centre of the storm is not abnormally heated, as in the case of a general storm, but is very much cooled. The bearing of this upon the generation of the thunderstorm is of great importance, and does not seem to have been sufficiently considered.

When the storm passes to the north or south of the observer, there is quite a brisk breeze from it, showing that the motion of the air is from it on at least three sides. Often it is possible to view the storm, in its onward progress, with clear sky overhead, if its border does not reach the zenith of the observer. Under these circumstances, one sees very distinctly up to the highest clouds a steady motion to the east. The rain is seen falling in great sheets, and its front is very distinctly marked. This rain front seems to be an important phenomenon, and has been seen scores of times advancing with a slight lagging at the earth and in the clouds. The appearance impresses one at once as caused by a rapid motion in the middle cloud region, with a lagging at the earth possibly from friction, and in the upper part of the cloud from a less velocity at that point. In no instance has there ever been observed an uprush of air anywhere in this region. These storms go in parallel lines, and as many as four have been seen running one behind the other, the most northerly one in advance. Often it is reported that a storm has gone slightly north of a station, and then turned and come back directly over it; but this is probably an illusion. The second storm has a motion the same as the first, but goes a little farther south. The motion across the country of these storms is about double that of the attending general storm to the north-west.

Probably the most marked characteristic of a thunderstorm, however, is a rise in pressure at its centre. This rise is universally conceded to-day, though its cause is in grave doubt. It has been repeatedly observed in storms where there has been no rain, and hence cannot be due to the cooling of the air by the rain, or to its downward pressure as it falls. How is it possible to account for this rise of pressure in a storm which is itself travelling more than a mile a minute? We have here to consider a phenomenon entirely distinct from a sand-whirl of the desert, which has only a slight progressive motion. There seems to be no doubt whatever that we are to consider here a cause or a condition which is inherent in the storm itself. There can be no upsetting of the equilibrium, no uprush of air just in front of a thunderstorm and nowhere else, which could give such a rise of pressure in so rapidly a moving body of air. We are certainly dealing here with a *plenum* which moves with the storm, and, in fact, is the storm itself. It may not be that this is due to a downrush of air particles from some height; but there is no serious difficulty in assuming that, through electrical action, there is an increased pressure in the centre. It is plain that the foregoing description has a most marked parallelism with that already given of the tornado, and it is virtually admitted that a tornado is simply an extreme development of a thunderstorm.

The attempt to show that while these phenomena are alike in most respects, and yet that in one of the more important factors they are entirely distinct, is most remarkable. We are taught that the origin of both is an unstable equilibrium, in both there is an uprush of air, in both there is a cloud of dust, in both there appear to be two clouds meeting from the north-west and south-west, in both there is a loud roar heard oftentimes, and in both there is a pronounced cooling. They are exactly alike, and produced the same way, but the final result of these actions is to develop two entirely dissimilar and almost opposite conditions. We are told that in a thunderstorm the air starts upward in the centre, has its moisture condensed by expansion, and the resulting precipitation cools the air, increases its density, and finally the diminished pressure at starting gives way to an increased pressure from this change in the density. It must be admitted that this is a reasonable conception, and may be true; but would not this at once destroy the ascending current, and bring the whole action to a standstill? Can we for a moment have both uprushing currents in a storm centre feeding its energy, side by side, with downrushing currents increasing the pressure? It is only necessary to state this contradiction in order to show the absurdity of the hypothesis. This theory strikes at the root of the whole process of liberation of energy in a moist ascending current; but more than that, if there is such a cooling and subsequent downrush, why should it not act in precisely the same manner in a tornado? How is it possible for this same uprushing current, which starts in exactly the same way in both these conditions, to continue upward in a tornado, to gather energy as it rises, to liberate more and more latent heat, to rush faster and faster, to grow warmer and warmer, and finally to produce the violent tornado with its supposed almost perfect vacuum in the centre, where a half-mile away there is perhaps a thunderstorm causing an increase of pressure? It would seem as though there could hardly be a plainer exposition of the utter futility of all the attempts that modern theorists have made to grapple with this problem, than this latest attempt to start the thunderstorm and tornado in the same direction, and finally bring them out, from almost the same conditions, facing in opposite directions, and absolutely dissimilar in their most essential characteristic.

Is it possible for electricity to produce a sudden increase of pressure in a mass of air sufficient to violently rend asunder objects which it strikes? Oftentimes the bark of trees has been driven off; and the usual explanation of this has been, that the heat of the electricity has converted the sap into steam, and this in turn has forced off the bark. This, however, is not satisfactory, for the reason that even a dead and perfectly dry tree has been struck, and scattered over a large field. A remarkable instance of explosive action in a lightning discharge is to be found in *Nature* for May 8, 1890. A tree standing in a rather open field was struck by lightning, and its fragments strewed over two acres of ground. One solid piece, weighing 5½ pounds, was thrown 378 feet. Other *débris* lay 210 feet in another direction. Small pieces of riven trunk and bark were found thrown in the teeth of the wind and 180 feet from the tree. The concussion or increase of pressure smashed six fine glass window-panes in a house not far away. Another very interesting effect was noted in a house that was struck in Washington, D.C., August 23rd, 1885. In this case the lightning struck the south-west corner of the tin roof on an ell built on the south side of the house, and divided. A portion of the flash passed down an eaves-spout; and at its end, which was two or three feet above the ground, it passed through the air to the damp side of the house, knocking off the plastering on the inside. The other portion of the flash passed down between the weather-boarding and the plastering on the east side shattered one of the upright posts, and appeared to explode off the weather-boarding toward the east, and the plastering toward the west. A woman and her two sons were apparently stunned by the effects.

While such cases have usually been regarded as "freaks" of lightning, yet it would seem that the matter has not been sufficiently studied to enable us to determine just what effect such a discharge would have upon a confined air space. It may be, the apparent bursting of a house in a tornado may be accounted for in this way. An instance has already been given at St. Louis of a rise in pressure, as shown by a barograph, and at the same time a seeming bursting of houses. Hardly a month passes that there is not some discovery regarding this extraordinary force of electricity, and surely we are not in a position to deny that it might not produce a large number of effects now observed in a tornado, such as searing of green leaves, discolouring the trunks of trees, increasing the pressure, exploding houses, depluming fowls, &c. We are told that lighting flashes are seldom seen in a funnel cloud. They have been seen there many times. Moreover, it is not at all certain that an ordinary observer would be in a condition to take particular notice of the presence of electricity in a tornado; and, again, the electricity may pass down or up the funnel without a visible flash. The presence of ozone has been often noticed in a tornado where no lightning was seen.

It has been my purpose for many years to avoid, as much as possible, all speculations in considering air motions and the causes of atmospheric phenomena. This is especially pertinent when we consider electric action in the atmosphere. It is very difficult to believe that electricity has nothing to do with our thunderstorms, and is merely a result, and never a cause. The fact that physicists have never yet been able to account for more than the smallest fraction of atmospheric electricity should lead us to greater diligence in determining its methods. We know from observation that the electric potential is enormously increased as we ascend in the atmosphere. That little or no connection between atmospheric electricity and storms has been observed by our instruments near the earth is not remarkable, since the earth and air just above it may neutralise all electric action for a hundred feet or more. Our thunderstorms seem to show an enormous storehouse of electricity at five thousand or six thousand feet above the earth; at least, electricity seems to be concentrated there over thousands of square miles during thunderstorm action. We are taught that electricity forms a sort of dual condition, or the electric field is a double one. May not this electric field draw on the sun for its energy? It is believed that light, heat, and electricity are all different manifestations of the same radiant energy. The abundant source of this energy is the sun. Why may not the sun's electricity, oftentimes observed by its direct effect on our magnetic instruments, and more often still indirectly in our auroras, be intercepted by a peculiar condition of the atmosphere or of the earth below, and thus be concentrated in particular localities? Generally this electricity passes through the air to the earth, but must we think that it always does so? May not this electric field or dual condition gradually develop in the atmosphere largely independent of the passage of air particles through wind or convection currents?

For convenience it has been generally considered that particles have a tendency to leave the positive and pass to the negative pole. For example: in the electric arc light the carbon at the negative pole is built up at the expense of the positive. The velocity of transmission of these carbon particles perhaps cannot be determined, but it must be only a very small fraction of that of electricity, 190,000 miles per second. Is there any inherent improbability in the supposition that in this dual condition in the atmosphere there is a tendency for moisture and possibly dust particles, positively electrified, to pass rather rapidly from the positive pole, or, better, positive portion of the electric field, to the negative portion? We know from observation that during the passage of a high area or clear sky the electric potential, with very few exceptions, becomes markedly positive, while during the fall of rain it is negative. While a thunderstorm is passing, there are most violent fluctuations of the electrometer needle from negative to positive and back again, as each flash of lightning is noticed. These fluctuations of the needle are perhaps a hundred times as great as under ordinary conditions of rainfall, and take place when the flash is a mile or two away, showing a most extraordinary inductive action upon the atmosphere, and for enormous distances. We have positive evidence of such transmission of moisture particles by a force entirely distinct from heat, pressure, or any other commonly recognised meteorologic condition. It is known that the moisture in the air is one of the most constant elements we have to deal with. The temperature may rise and fall thirty or forty degrees during the day, and yet the quantity of vapour is in no wise changed. The wind, either in direction or velocity, does not change this moisture. The hiding of the sun's heat or light in no wise affects it. Changes in air-pressure produce no effect in general. As a storm approaches, however, we find a most marked increase in this moisture over thousands of square miles, and this even in a calm. As a storm passes off, the conditions are sharply reversed. The moisture becomes depleted in a most remarkable manner, as though it were actually drawn out of the atmosphere by an invisible agency.

The most remarkable example of such action was observed on December 22nd, 1889, from a third-story window of a house in Washington. It will be seen that the conditions were not favourable for observing this effect at its best. At 3.11 p.m. there were 4·09 grains per cubic foot, and for more than 24 hours previous there had been an abundance of moisture from a storm passing near by. The air was almost a calm, and continued so till nightfall. At 5.2 p.m., or 111 minutes later, there was only 1·04 grain per cubic foot, and this continued as long as observed. To any one who has made determinations of the moisture of the air, and noted its great constancy, frequently for several days, this sudden subtraction must be very extraordinary. If such changes are possible near the earth, and in the centre of a large city with houses for more than a mile on all sides, what may we not expect to take place in the free air, where there are no interferences, and where we know that such forces are acting in far greater intensity than near the earth?

Just after a thunderstorm or tornado there are torrents of rain, and in some quarters it is getting to be quite the custom to call such phenomena cloud-bursts. In these cloud-bursts almost an incalculable amount of rain falls, more than a foot having been reported at times. In one case 4 feet of hail were reported. Just how much territory is covered by such a cloud-burst cannot be told, as the data are not sufficiently numerous, but 50 or 60 square miles may be easily considered. We have already seen that the later theory, which calls for a downrush in the centre of a thunderstorm, effectually disposes of all possibility of this enormous amount of moisture rushing up in the centre and being condensed by expansion. In the case of a tornado, it is incredible that even a thousandth part of this moisture can be carried up in a funnel a few hundred feet in diameter. If we inquire what would be the effect of the ordinary condensation of such a mass of water in the air over such a limited space, we are confronted by an amount of heat set free that is simply appalling. One gallon of rainfall gives out sufficient heat to melt 45 lbs. of cast iron. A very little consideration will show us that it is absolutely impossible, even allowing a current of moist air at any conceivable velocity, for even a small fraction of rain to be precipitated out of such a current. It has already been shown that the latent heat set free would at once re-evaporate the moisture. We seem to be driven to invoke the aid of some other agent than any thus far recognised as cogent in producing our storms. Is it inconceivable that we have to deal here with a negative electric field, which draws to itself with great velocity particles of moisture from regions perhaps for 100 miles about, when suddenly, upon a discharge of electricity, the potential upon the particles is diminished, and they unite in great abundance and form raindrops? This is a most inviting field for observation. We already have facts enough to make a plausible hypothesis, and, what is very important, we have here an unlimited amount of energy which may be called upon to produce all the effects ever observed.

It is not a little remarkable that the earlier views all ascribed tornadic action to electricity, and it would seem as though the time were not far distant when we would be forced to return to this agent for explaining the phenomena. What are needed are careful experiments in this most enchanting field of research. An attempt has been already made to test the question of the transmittal of moisture through the air by electric action. A Holtz machine was run for 15 minutes in a rather large room; and most careful measurements of the amount of moisture at the machine and at a point 20 feet away, before and after the machine was in action, showed an increase at the machine. When we consider that it was impossible to measure the moisture contents just at the plate of the machine, and also what an extremely slight charge could by any possibility enter the air from the machine, we can but be surprised that any effect at all was observed. With improved methods of observation by which the exact hygrometric state of the air can be easily and accurately determined, and with very accurate tables of reduction which we now have, all that is required is an observer for investigating these phenomena. The expense for apparatus need not be great.

SHIP LIGHTING PLANT.

DURING the visit of the members of the Institution of Electrical Engineers to Edinburgh, Dr. Walmsley read a paper on "Some Chief features, mainly Electrical, of the Edinburgh International Exhibition, 1890." In the section devoted to electric lighting, there appears the following paragraph, which, with the table mentioned, we here reproduce:—

Considering the position of the exhibition, it is but natural that most of the exhibitors of dynamos and engines should include a set of ship lighting plant amongst their other exhibits. For the convenience of those visitors who are interested in this branch of electrical work, I have embodied in Table A a few particulars of the different combinations that are open to their inspection. In the last column I have calculated as being of some interest the number of watts available in the outer current per square foot of floor space occupied. Of course, I do not mean to imply that this is the only or even the most important thing to be considered in selecting ship lighting plant, but it is interesting as showing what can be done in this direction. In comparing these numbers the steam pressures given in another column must not be overlooked.

Exhibitor.	Engine.	Steam pressure.	Speed.	Dynamos.	Kilowatts in outer circuit.	Floor space.	Watts per square foot of floor space.
King, Brown & Co.	Compound vertical 7½in. × 12in. 12in. × 12in.	120	300	King, Brown & Co.'s four-pole, compound wound	44	8ft. 6in. × 3ft. 0in. = 25ft. 5in.	1725
King, Brown & Co.	High pressure vertical 6¼in. × 6in.	160	285	King, Brown & Co.'s single magnet, compound wound.........	12 6	5ft. 6in. × 2ft. 9in. = 15ft. 1in.	834
Ernest Scott & Co.	High speed vertical 6½in. × 6in.	80	380	"Tyne" slow speed compound wound ...	4·8	6ft. 0in. × 3ft. 0in. = 18ft. 0in.	267
Brush Electrical Engineering Co.	High pressure vertical 8in. × 6in.	80	300	Victoria, compound wound	6·5	6ft. 0in. × 2ft. 8in. = 16ft. 0in.	406
India Rubber, Gutta Percha, and Telegraph Works Co. ...	Globe compound automatic vertical 8½in. × 8in. 15in. × 8in.	100	300	Silvertown, single magnet, compound wound	36·75	9ft. 10in. × 4ft. 3in. = 41ft. 8in.	872
Napier, Prentice & Co.	Either compound 4in. × 5in. 8in. × 5in. or two high pressure horizontal	100 50	550	Napier-Prentice double magnetic circuit, two pole	11·0	... = 31ft. 0in.	355
Norman & Son	Sabberton Bros.' high speed vertical 6in. × 9in.	80	260	Laurence, Scott & Co.	4·5	5ft. 6in. × 2ft. 8in. = 14ft. 8in.	304
Norman & Son	Single acting cylinder 3in. diameter	60	...	Laurence, Scott & Co.	0·48	2ft. 3in. × 1ft. 2in. = 2ft. 6in.	185
E. S. Hindley	High pressure vertical 7in. × 8in.	60	...	Phœnix	5·2		

PROCEEDINGS OF SOCIETIES.

The Institution of Electrical Engineers.

THE following discussion took place on Mr. BENNETT's paper on 'Foreign Currents," read at the Edinburgh meeting.

After the CHAIRMAN had proposed a vote of thanks to Mr. Bennett for his paper,

Mr. W. H. PREECE said he had been asked to supplement the remarks that Mr. Bennett had made, as regarded foreign currents that were traced, and were found not only in ærial conductors but in other conductors. The phenomena that Mr. Bennett had brought before them was, he thought, indicated in Fleming Jenkin's book on electricity, where he showed that with an insulator, in wet weather, there must be currents of polarisation, *i.e.*, the currents passing through by leakage—the moisture from the insulator decomposes the water in its constituent elements and the formation of gas must produce these currents of polarisation. Practically these currents did not produce any serious detriment on their telegraphs. There was no doubt that the transmission of signals in wet weather was slower, more sluggish than in fine weather, due to these causes. But there were other currents found in the wires not traceable on telegraphs, but very readily perceptible on telephones. He did not know whether any one present had amused themselves, as he had done by spending a whole night in a telegraph office with telephones to his ears, tracing the effect of the foreign currents. The sounds were sometimes most remarkable. Occasionally they heard a slight scream, not unlike a scream of pain from a child. At other times sounds were heard which had been likened to a cry of a young bird. One explanation given was that as the wires swing across the lines of force of the earth, there was an electromotive force set upon these wires, and when there was a long swing there might occasionally be a summation of all these vibrations that would produce a succession of currents resulting in these peculiar sounds. There was a very troublesome source of foreign currents on their wires, due to the introduction of the alternate current system of generating the electric light. That occurred in the case of the London Electric Supply Corporation, who had given the Post Office very evident cause of their presence down at Deptford, in fact, most of their wires to the South had been more or less disturbed, and so great was the disturbance at one time, that it was felt at Paris. There was another source of disturbance due to the working of the tramways. It was felt at Blackpool, for instance, in the taking up and setting down of passengers. Most of these that he had referred to were foreign currents due to effects—very well known effects of induction, easily measured—carried to immense distances. The phenomena Mr. Bennett had brought before them were really electro-chemical, due more to the ordinary elementary principles associated with the ordinary construction of batteries, and although they might be interesting, he did not think they were very serious. He thought if they had the slightest influence on the speed or accuracy of the work of the telegraph it would not have taken them forty years to secure evidence of their existence.

Mr. Heaviside, Newcastle, said that in his district they made use of the effects to which Mr. Bennett had referred in their insulators. They were constantly removing iron wire and placing copper wire on the poles. The iron wire left behind it oxide of iron, and when they placed copper wire in position they gradually got the effects mentioned by Mr. Bennett.

Mr. Bennett stated in reply that the effects he had brought before the Conference were entirely wet weather effects. Those mentioned by Mr. Preece were mostly noticeable in dry weather. Although the voltaic action, and polarisation of the bolts had not hitherto been noticeable, he thought the effect was due to the use of iron wire exclusively. Recently copper was replacing iron all over the country, and the results noticed hitherto might be expected to increase considerably. Respecting the disturbance which might be expected from a more extensive introduction of electric tramways, a gentleman from Boston who was in Edinburgh recently, had told him that they did not hope to make any great use of the telephone system after nine o'clock at night, owing to the fact that the electric light in Boston came into operation after that hour. The telephone system was very much worse now than before the electric tramways were introduced into Boston. The fact was very serious indeed, and had given rise to endless litigation between the Telephone Company and the various tramway companies in the States. This was a matter they must endeavour to guard against in this country. It must be done in one of two ways, either by compelling the Tramway Company to use metallic circuits everywhere, or by the Telephone Company using them themselves. (Applause.)

The Conference then adjourned, and the members, after lunching, were conducted over the Exhibition, devoting their attention specially to the electrical sections.

Discussion on Prof. Ayrton's Paper.

Mr. Preece, who occupied the chair when Prof. Ayrton's paper was read, called upon Prof. Perry to open the discussion.

Prof. Perry said it was impossible for them to be prepared to discuss a paper on so short a notice, a paper which had taken years of work. It completely transformed their old notions. He was astonished at the large working efficiencies that had been obtained. It seemed to him a thing of enormous importance that those observations had been made by those who had absolutely no pecuniary interest in the matter. He had no doubt that makers were perfectly honest, and the results they gave were fair, but he liked to have an utterly independent set of observations. He admired the ingenuity which had been shown in the designing of the apparatus for keeping the current absolutely constant during charge or discharge, at the same time it might appear to him as a personal waste of energy. It seemed to him a terrible thing that such an enormous amount of thought should be devoted to work simply for the general good of the profession, and not at all for the general good of the authors of the paper; he was sure that they had exceedingly little to gain, compared with the enormous amount of work.

Mr. Kapp expressed himself pleased with the efficiencies of the cell, he would, however, suggest that the discussion should be continued at the next ordinary meeting of the Institution, when everybody would have read the paper, it would receive the discussion it deserved.

Lord Bury said he had employed secondary batteries to a very considerable extent and had put them to searching practical tests, the result of which was that they could be relied up to a greater extent than was generally believed. There were many improvements now being made in the practical development of these cells, one of which had been lately initiated by his friend Mr. Barber Starkey (See Electrical Review, July 18th), by which the rough usage to which they were subjected in the course of tramway traction, could be very much counteracted.

Mr. Fraser gave an account of some experiments which he had carried out three years ago in regard to the variation of resistance in relation to current. He was favourably impressed with the method adopted by Mr. Barber Starkey, but he would wait until the end of the life of cells to see proof of their superiority. After remarks by M. Hospitalier and Mr. Swan,

Mr. Preece considered, before he called upon Mr. Smith to reply on behalf of the authors, it would be only fair to them that he (the Chairman) should make any remarks he had to make. He was bound to confess that at the present day there was no subject of greater importance to the electrical engineer than that of the proper performance of secondary bateries. They were coming into use more and more every day, not only for the comfort of those who have their houses lighted by electricity, but for those who travel by railway trains. In every branch of electrical engineering secondary cells were being used. The speaker dwelt upon the fact that there was a great prejudice against the use of secondary batteries, and it was based on the supposition that they were very inefficient. Though a few of them had long felt that the battery was not quite so efficient, the majority would feel that the authors of the paper had done a great work indeed throughout the profession, the unmistakeable figures before them showed that a secondary battery was not a very inefficient machine. Again, it had an important bearing on the question of distribution of electricity over large areas. The favourite system at the present was to distribute currents over wide areas by means of alternating currents and secondary generators, but there were those who believed in the future of secondary cells and who thought the day was not far distant when secondary batteries would knock out of the field the secondary generator. He, the speaker, was not one of those. He firmly believed in the secondary generator. One great drawback, however, in this system, had been their very low efficiency, and this was attributed to the inefficiency of the battery. He had very good reason to think that it was due not to the secondary cell itself, but to the methods which were adopted to charge and discharge the cells. In connection with this there was a fallacy which was very widespread, and it was, that because in charging a secondary battery they work up to an E.M.F. of 2·4 or 2·5 volts, and in discharging, you get down to about 2·1 volts, therefore there was a loss of efficiency of 25 per cent. in the battery; it was one of the most absurd fallacies ever perpetrated, and its fallacy was shown by the tables of the makers of secondary batteries; it is perfectly theoretically possible to get as much out of your battery as was put in, but practically it is not so. One of the most important features of the paper showed that necessarily there was a loss of energy in the cells owing to the action at the surface and diffusion of energy into the surrounding atmosphere. Practical men had arrived at very much the same conclusions as the authors of the paper. It had always been satisfactory for them to find that their conclusions had been borne out by accurate scientific investigations. They had long ago come to the conclusion that the E.M.F. of a cell should never be allowed to fall one point. He referred to the use of cells in his own house, which had been there for several years, and he had not had the slightest flicker of the light, which was entirely owing to the fact that the cells had been treated as secondary cells should always be treated, with great care and consideration. Cells which they had in the Post Office six years ago were still in existence. He (the speaker) had never yet succeeded in breaking or using up a single cell he ever had in his possession. The first cells he had were the Elwell-Parker type of Planté. They had tried all the types of E.P.S. which were in existence, in his own house. He liked them at home to experiment with, and if anyone would submit a battery cell, he would not hesitate to replace them and give them practical tests. Practice had introduced another test, one of great value indeed, and he would continue to call most earnest attention of those who wished the cell to prosper, always watch the performance of the electrolyte, never mind the E.M.F.; take care of the internal resistance, and to measure the density of the liquid by means of a hydrometer. In his room at the Post Office a book is kept recording the density and performance of every cell, and they could tell at once how a cell was behaving. Mr. Barber-Starkey had referred to the fact that he had introduced soda into his cells. He (the speaker) was very much struck, when visiting that gentleman, to see in what beautiful condition his plates had been brought to, and he was shown it was entirely due to the use of soda. Mr. Starkey applied it in a very rough-and-ready kind of way, he bundled some carbonate of soda into the cell and there remained sulphate of soda, which mixed with the cell. He (the speaker) was so well satisfied that there was so much in this that he organised a long series of experiments, lasting for nearly two years, to determine the proper proportion which should bear between the use of soda and sulphuric acid, and the conclusion arrived at was as follows, the solution was tried in the E.P.S. type, which is a cell taking 45 pints of electrolyte, made up of 39 pints of water, 5 pints of sulphuric acid of the highest specific gravity, and 1 pint of saturated solution of sulphate of soda, and the plates looked as bright and as beautiful as one could wish them to be. In conclusion, the speaker said the apparatus used by the authors reminded one of that brought two or three years ago before the notice of the Institution by Mr. Edmunds.

Mr. Smith, on behalf of the authors, briefly replied, and the meeting adjourned.

NEW PATENTS—1890.

11788. "Improvements in electric arc lamps." S. P. Parmly. Dated July 28. (*Complete.*)

11817. "Improvements in electric light fixtures." F. H. Aldrich. Dated July 29. (*Complete.*)

11862. "Improvements in electrostatic measuring instruments." W. E. Ayrton and T. Mather. Dated July 29.

11863. "Improvements in electric switches." W. W. Strode and C. G. Gill. Dated July 29. (*Complete.*)

11883. "Improvements in the distribution of electricity, and in the apparatus employed therein." T. Tomlinson. Dated July 29.

12009. "Improvements in electric indicators and in bells, applicable also to other purposes." J. S. Ross. Dated July 31.

12094. "An electric fuse for firing guns." R. **Morris**. Dated August 1.

12119. "An appliance for holding the brushes of dynamo-electric machines while being repaired." H. **Hollingdrake**. Dated August 2.

12169. "Improvements in and relating to apparatus for measuring electrical energy." L. A. W. **Desruelles** and R. F. O. **Chauvin**. Dated August 2.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1889.

4484. "Improvements in the regulation of electric currents." W. M. **Mordey**. Dated March 14. 8d. Relates to the use of a small apparatus which the inventor calls a corrector, resembling a transformer in construction, and consisting of a suitably laminated iron core or sheath provided usually with two coils of wire. The corrector is wound with two windings, one of comparatively fine wire, which is connected as a shunt to the secondary terminals of the transformer, and thus is in parallel with the lamps. The other coil is of a thicker conductor, and has a smaller number of turns, and is connected in series with the lamps—that is to say, it is connected between one of the secondary terminals of the transformer and one of the secondary mains, the other secondary main being connected directly to the other secondary terminal of the transformer. The shunt winding may be connected across the secondary and the series winding combined, that is across the lamp terminals, instead of to the secondary terminals. The two circuits of the corrector are arranged to be traversed by currents in the same direction. The shunt or fine wire winding of the corrector, which is called the initial winding, is designed so that when connected to the transformer alone it receives such a current that the iron receives a certain initial magnetisation. In this condition the corrector opposes a certain impedance, opposing E.M.F., or choking action to any small current through its series winding, the effect, when a small number of lamps is switched on, being to reduce the potential difference available in the secondary circuit, to a value somewhat below that existing at the secondary terminals of the transformer. On the passage of a larger current in the secondary circuit, as when more lamps are switched on, the opposing E.M.F. or choking action of the corrector becomes reduced on account of the saturation of the iron, and a larger potential difference is made available in the secondary circuit. This effect is produced with only a trifling expenditure of energy, and the corrector is not to be taken as equivalent in this respect to a resistance. 2 claims.

6520. "Improvements in or relating to electrical motors for clocks and similar apparatus." W. P. **Thompson**. (A communication from abroad by Günther and Louis Hoppe, of Germany.) Dated April 16. 6d. Has for its object a motor in which the power of an ordinary or permanent magnet is utilised to actuate a vibrating arm in one direction in such a manner that on the end of its stroke an electric circuit shall be automatically closed, which energises an electro-magnet, the power of which is used to return said vibrating arm. The arm being thus vibrated, the clock or other mechanism is actuated by means of suitable connections. 2 claims.

7796. "Improvements in supporting electric conductors." W. A. S. **Benson**. Dated May 9. 6d. The inventor binds together the insulated conductors forming part of an electric circuit or part thereof by a wire or wires wound spirally around them, which wire gives an ornamental appearance to the conductors, and lessens risk of the conductors becoming injured. In order to take any longitudinal strain, he lays wires parallel to the conductors and within the spiral binding wire. Upon the outside of the conductors he passes a tube, screw-threaded on the outside; this tube is slotted to receive the longitudinal supporting wires and the end of the protecting wire, which are passed through inside it and turned backwards in the slots, a cap or outer tube is then screwed on, whereby the longitudinal wires and protecting wire are firmly held. This cap or outer tube has attached to it a disc or bracket to be fixed to the wall, ceiling, or other place from which it is desired to suspend the conductors. 2 claims.

7883. "Improvements in electro-motors and apparatus used therewith for dental and other purposes." T. **Cuttriss**. Dated May 11. 6d. Consist of an arrangement for instantly stopping the rotation of the burr, drill, stone, or other tool actuated by the motor, by making use of an electro-magnet for actuating a clutch arrangement attached to the motor, the current for working the electro-magnet being preferably obtained from the same source as used for driving the motor. 2 claims.

8030. "Improved automatic switch for charging electric accumulators and like purposes." M. E. **Unger**. Dated May 14. 6d. A disc of insulating material is mounted on a shaft revolving in bearings. Around the disc are a set of metallic coatings, corresponding to the number of contact connections to be made. The coatings are insulated from one another step like on the disc, their number being one more than the number of the series. On the disc there are also places not coated with metal which correspond to the several segments of the contacts. The contact surfaces are passed over and alternately rubbed by springs in communication with the source of electricity, and which conduct the current to the metallic coatings from which proceed short metal strips, and from these latter short wire connections to contact rollers fixed insulatedly on the same revolving shaft as the disc. The rollers rotate in quicksilver vessels, insulated from one another, and in which dip springs that are in connection with the corresponding poles of the series. The uncoated parts of the disc serve upon the sliding off therefrom of the springs to interrupt the current from the contact surface in connection with the last negative pole of the series, until upon the further turning of the disc a spring once more comes in contact with a contact surface in connection with the negative pole of the corresponding series, so that by this means short circuiting between the poles of the secondary batteries is prevented. 2 claims.

8692. "Improvements in multiple switch board systems for telephonic exchanges and wire bands to be used therein." J. E. **Kingsbury**. (A communication from abroad by the Western Electric Company of Chicago) Dated May 24. 8d. The object of this invention is to dispose the wires at the rear of the switch board in such a manner that they may be spread out to the rear without occupying an undue amount of vertical space, and at the same time to change the positions of the different wires relatively one to another as they pass from section to section, so that no two telephone wires may remain in close proximity to one another for any considerable distance. This is effected by making up or weaving together the wires into flat bands, preferably of a depth of a single wire only. 7 claims.

9119. "Improvements in electric bells and indicators." E. T. **Fiford**. Dated June 1. 6d. Consists of a pendulum, suspended in front of the bell from a stud or bracket. A small soft iron armature is fixed on the pendulum rod opposite the pole of an electro-magnet attached to the bell frame. When a current is sent through the bell coils, it also passes through the coil of the aforesaid electro-magnet, and attracts the pendulum; as soon as the bell stops ringing the pendulum is released and swings, indicating that the bell has rung. 4 claims.

9133. "Improvements in the manufacture of carbons or electrodes for electric lamps." H. H. **Lake**. (Communicated from abroad by Messrs. Lacombe & Co., of Paris.) Dated June 1. 6d. The inventor places between discs or other pieces or layers of carbon a layer of a material composed of a mixture of carbonaceous and silicious substances, or any suitable composition or material which, while not interfering with the proper working of the lamp, will by reason of the better conduction of the electrical current ensure the retention of the arc in a fixed position, and the consequent steadiness of the light. The pieces or layers of carbon, with the steadying substance above mentioned between them, are preferably subjected to a high degree of compression so as to consolidate the mass, and increase the density and homogeneity thereof and the duration of the electrodes. 5 claims.

9162. "Improvements in the armatures of dynamo machines." C. E. L. **Brown**. Dated June 3. 8d. Claims:—1. The construction of a drum wound armature, in which the wires between which the maximum difference of potential may exist are completely separated over the whole armature and throughout their length by an interposed continuous sheet of insulating material, one half the wires lying at one side of the said sheet, and the other half at the other side. 2. The improved method of winding and insulating the wires of drum armatures, substantially as described with reference respectively to and shown in the drawings.

9304. "Improvements in switches for electrical purposes." W. **Barnicoat**. Dated June 4. 6d. The inventor arranges segmental opposite plates on the base of the instrument, which are secured thereto by a screw, the said screws also clamping the terminal wires to each plate. He mounts a tongued contact-maker or breaker always in connection with one plate on a spindle of irregular shape, adapted to fit a key possessed only by those in charge of the plant, so that careless, mischievous, or insane persons (such as in an asylum) cannot tamper therewith. He covers this spindle by a guard plate with a hole to insert the key, and to prevent possibility of shock, he insulates the key part of the spindle from the contact-breaker in any suitable manner. To ensure the contact-maker or breaker being always "on" or "off," he mounts on it a cam or eccentric (which may carry a small friction roller if desired); this bears against a plunger set up by a spiral spring carried in fittings on the base. 4 claims.

9284. "Improvements in metallic telephone circuits." H. L. **Burbank**. Dated June 4. 8d. Consists in certain arrangements of the circuits with respect to the several appliances at the several stations, whereby when all the stations are at rest the several call bell helices and call bell generators are serially connected in circuit, so that each station may receive a call from, or send a call to, the central station or exchange calls with each other, and whereby the calling circuit of both is opened when either station is using the line for conversation. 3 claims.

10801. "Improvements in electric lamps." H. **Pieper** fils. Dated July 4. 8d. Claims:—1. In an electric lamp, the combination of a carbon rod, an electric circuit, two or more electrodes in contact with one end surface of said rod, one or more of the said electrodes being movable with its, or their, contact point or points lengthwise to the rod and means for pressing the movable electrode or electrodes against the end surface of the same, substantially as described. 2. In an electric lamp, the combination of a carbon-rod, an electric circuit, and two or more electrodes in contact with one end of the said rod, one or more of the said electrodes being tubular and inclined upward from their points of contact with the carbon, substantially as specified. 3. In an electric lamp, the combination of a carbon rod, an electric circuit, two or more electrodes in contact with one end of the said rod, one or more of the said electrodes being movable, means for pressing the movable electrode or electrodes against the carbon rod, contact surfaces on the movable electrode or electrodes, other contact surfaces arranged opposite thereto, and each of which is conductively connected to the pole of the lamp, being of different denomination from that to which the corresponding movable electrode is connected, substantially as set forth.

20260. "Improvements in electric semaphores for railways." F. STITZEL, C. WEINEDEL, A. REUTLINGER, M. J. SCHWARTZ, J. H. EGELHOFF, and J. KREIGER, Sen. Dated December 17. 8d. The object of the invention is to provide an electric semaphore apparatus which shall be simple in construction and effective in operation. A further object is to provide an electric semaphore apparatus which shall be sensitive and positive in operation, and require but a small amount of battery to operate it. A further object is to construct the device that its signal blade may be made to stop at each half revolution, to impart different information according to its position—said blade being entirely hid within a shield when in a vertical or "safety" position. A further object is to construct an electric semaphore in such a manner that a visual blade and night signal may be operated by the same mechanism. A further object is to provide an electrical semaphore apparatus with a rotary signal blade and a night signal, both of these signals being operated simultaneously by the same mechanism. 11 claims.

CORRESPONDENCE.

The Lineff System of Electric Traction.

I trust you will allow me brief space for replying to Mr. Lineff's courteous answer (in your last week's issue) to my recent remarks upon his system; not desiring to be esteemed by anybody as one of that sadly too numerous class who rush into places—especially into print—where angelic beings even are remarkably afraid to venture.

Since writing, a fortnight ago, I have had the advantage of being "personally conducted" over Mr. Lineff's system, so as to see all the ins and outs thereof; and, in the first place, as a result, I want to say that his new method is certainly a very great advance on the old. In my humble opinion, indeed, it ought to prove fully the best, in point of first cost and working expenses, of all the underground systems hitherto devised.

But one still cannot help feeling that Mr. Lineff has a little further to go before reaching perfection; and though suggestions from an outsider are perhaps ill-timed, yet the necessity for a more solid foundation as regards the magnetic rail sections, constantly is prompted to the mind.

I certainly believe that a continuous channel of cement set in the asphalte insulation would prove more serviceable than the tiles which Mr. Lineff proposes to employ.

The incessant jarring of wheels upon the numerous exposed rail-edges (which must result from the different coefficients of wear or compression in iron and asphalte) ought very soon to show how much the earthenware tiles—which support the magnetic rail sections—can stand in the way of blows.

It would be very interesting to watch the effect which the ordinary street traffic will produce upon the inch thickness of asphalte underneath the tiles.

If the bottom of a very thick layer of asphalte remains fairly elastic whilst a hard skin is formed by traffic on the exposed top, then it might be found that the iron and asphalte surfaces would settle down at pretty much the same rate.

With regard to the question of surface leakage, it appears almost as though the report did not say enough for the line, for the test which resulted in the lowest figure for insulation was decidedly abnormal.

The difference between the highest and the lowest is so great that anyone might well be excused for thinking there was a "nigger" in it.

Thus measurements taken at various times might show resistances of 4,000, 3,000, 3,500, 3,700, 3,200, 2,750, and so on, with, perhaps, one abnormal record of 600. In a case like this, one would say that the average resistance is certainly not $\frac{4{,}000 + 600}{2}$, but considerably higher. The fault lies in not taking a sufficient number of instances.

I still, however, think that a wise man will only reckon with certainty upon his lowest figure, even though it be somewhat abnormal. Twenty per cent. dividends from a company that is only supposed to pay five are pocketed with far more cheerfulness than 25 per cent. from one that ought to give 30.

Another point to be mentioned is the diminished size of motor required for the Lineff car as compared with accumulator cars. But Mr. Lineff knows quite well that the output of motors increases in much greater proportion than the lineal dimensions and mass, or weight, either; and a very little extra weight in the motor is enough to give the increased power required by reason of the accumulator dead-weight.

As for the weight of the car itself, the present car frames are amply strong enough to carry the accumulators, and nothing need be added for that purpose.

I am sorry the illustrations of this system, published before my last letter, escaped my notice. I usually devour most of the technical journals, more or less dyspeptically, but lack of time must have caused me to overlook this item. It makes no difference, however, as Mr. Kapp's report contained a very good verbal description of the line.

I am glad to hear that the Lineff system is shortly to be tried on a larger scale in practical work along the West Metropolitan Company's line (subject to the permission of that august body, the Hammersmith vestry), and I sincerely wish Mr. Lineff every possible success. Every electrical engineer is anxious enough to see electric traction introduced all over this country, and, personally, I do not wish in any way to act as a brake upon invention. I only hope to be convinced that the Lineff system will, for some time to come, be able to show publicly the great benefits of electric traction, so that later on the converted Englishman will calmly submit to overhead tramway conductors, or anything else that is reasonable.

Frank B. Lea.

August 12th, 1890.

Fall of Potential.

I have an engineering pocket book which gives me the loss of potential in 100 yards of, say, a strand of 7/16s, with a current of 10 ampères, which is used at the distant end. The loss of potential is given as 2·21 volts on the basis of the 1,000 ampères per square inch section of conductor. Now, I understand how to arrive at the loss of potential, if I either increase or decrease the length of my cable, keeping the current constant; but, suppose I want to pass 15 ampères through a length of 75 yards, what is then the fall, length and current both being altered?

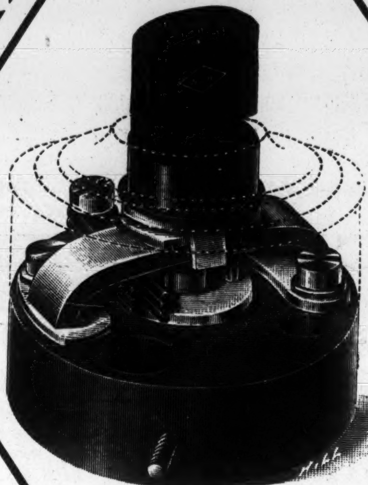
Works Manager.

[The fall of potential along any wire is simply the current passing multiplied by the resistance between the two ends of the wire. In the example you give you have taken the fall of potential over *half* the circuit only instead of over the whole length, viz., 200 yards. If the wire has a resistance of ·11 ohm per 100 yards, then the resistance of the total circuit (200 yards) will be ·22 ohm, and as the current is 10 ampères, the fall of potential will be $\cdot 22 \times 10 = 2 \cdot 2$ volts. For a *total* length of 75 yards, *i.e.*, a loop of 37·5 yards, the resistance will be $\frac{75 \times \cdot 11}{100} = \cdot 085$ ohm, and if the current be 15 ampères the fall of potential will be $\cdot 085 \times 15 = 1 \cdot 275$ volts. For a *loop* of 75 yards, *i.e.*, a total length of 150 yards, the fall of potential from end to end would of course be double, *i.e.*, 2·55 volts:—EDS. ELEC. REV.]

W. R.

THE
DIAMOND
TYPE.
Unequalled for Strength,
Current Capacity,
and Quality.
5, 10 & 20
Amp.

SWITCHES
10,000
IN STOCK.
LARGEST MAKERS IN THE WORLD.

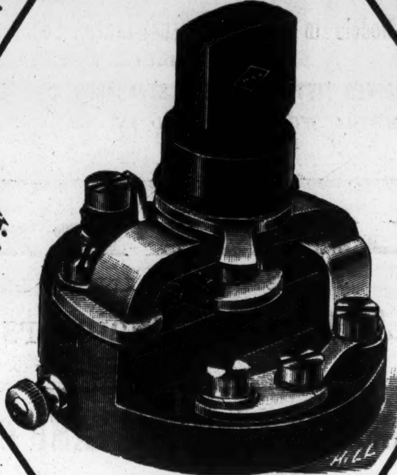


5 AMP. QUICK
Break "◇" Switch
Without Fuse
Terminals.

For
PRICES
of
SWITCHES
for
ELECTROLIERS,
ACCUMULATORS,
DYNAMOS,
VOLT AND AMMETERS,
&c., &c.
Strand Works, CHISWICK, W.

TRADE MARK.
W. & R.

CUT-OUTS
10,000
IN STOCK.
LARGEST MAKERS IN THE WORLD.



5 AMP. QUICK
Break "◇" Switch
With Fuse
Terminals.

For
PRICES
of
CUT-OUTS
for
MAIN & BRANCH
CIRCUITS,
SWITCHBOARDS,
ACCUMULATORS,
MAGNETIC CUT-OUTS,
&c., &c.
Union Foundry, KIDSGROVE.

WOODHOUSE
and
RAWSON
UNITED, LIMITED,
88, Queen Victoria St., LONDON, E.C.,
And at Bradford and Manchester.

REID BROTHERS,
12. WHARF ROAD. CITY ROAD. LONDON, N.
TELEGRAPH ENGINEERS AND CONTRACTORS
For the Supplying, Erecting, and Laying Down Under-Ground Wires both for
TELEGRAPHS AND ELECTRIC LIGHTING
PNEUMATIC TUBES FITTED WITH ENGINES AND PUMPS COMPLETE.
MAKERS OF RADCLIFFE'S PATENT ELECTRICAL SIGNAL LOCKING APPARATUS.
PATENT TELEPHONIC WIRES
TO PREVENT INDUCTION BOTH FOR UNDER-GROUND AND OVER-HEAD LINES.
MANUFACTURERS OF SUBMARINE CABLES, WIRE, IRON POLES, INSTRUMENTS, BATTERIES, INSULATORS AND STORES OF EVERY DESCRIPTION.
Contracts entered into for the Supply, Construction, and Maintenance of Telegraph Lines.
209

CALLENDER'S BITUMEN TELEGRAPH & WATERPROOF Co.,
LIMITED.
101, Leadenhall Street, LONDON. Telegrams: "CALLENDER, LONDON." Telephone, No. 4,485.
LIVERPOOL: 36, Dale Street.
Works: ERITH, KENT. Telegrams: "CALLENDER, PICARDY." Telephone, 8,411.
UNDERGROUND MAINS
LAID COMPLETE ON CALLENDER-WEBBER OR SOLID BITUMEN SYSTEMS.
LEAD SHEATHED WIRES AND CABLES
FOR UNDERGROUND WORK, HOUSE AND FACTORY MAINS AND SHIP WORK.
Concentric Cables—ARMOURED—Metal Sheathed.
AERIAL CABLES.
1335

Telephone No. 2,648.

B. VERITY & SONS,

Telegrams: "Electroler, London."

COVENT GARDEN.

HIGH-CLASS ARTISTIC ELECTRIC FITTINGS

Designed by S. CRICHTON HANNAH, Esq.

(*Exhibitor at the Royal Academy*, 1887—1888.)

Valuable Models in Stock of Renaissance, Louis XV., Louis XVI., Girandoles adaptable for the Electric Light.

SKILLED MODELLERS AND CHASERS EMPLOYED.

SILVER AND COPPER FITTINGS, COPPER STANDARDS, COPPER AND GLASS SUSPENSIONS, COPPER CEILING LIGHTS, COPPER BRACKETS.

METAL WORK FINISHED IN GOLD LACQUER, ORMULU, ELECTRO OR MERCURY GILDING. 3510

ELECTRIC CRANES,

TRAVELLING, PORTABLE AND FIXED. 3671

R. BOLTON & CO., Engineers, 110, Leadenhall St., LONDON, E.C.

THE BERNSTEIN ELECTRIC LAMP CO.,

(LIMITED),

2, MARLBOROUGH MANSIONS, VICTORIA ST., LONDON, S.W.

OWNERS of the BERNSTEIN SYSTEM of ELECTRIC LIGHTING.

☞ The lamps of this Company are of low resistance, and entirely free from the claims of other companies. 1120

EXCELSIOR

ELECTRO-PLATING DYNAMOS

For Nickel and Silver Plating, Brassing, Electro-typing, &c., as used by all the principal Platers in London.

PRICES FROM £6. Numerous Testimonials.

VATS, ANODES, AND COMPLETE OUTFITS. 3764

CARL OPPERMANN, 41, Sigdon Rd., Hackney, N.E.

THE "DODGE"

WOOD SPLIT PULLEYS

Are superior in every way to those made of iron.

Their Gripping Power is enormous, and they are 40 per cent. lighter than iron or steel. By their use from 25 to 60 per cent. more power can be transmitted with the same belt.

One Pulley will fit 22 sizes of shaft.

They give entire satisfaction wherever used. We offer to intending purchasers a Pulley on Trial for 30 days, and, if unsatisfactory, it can be returned.

A large stock held for immediate delivery.

ISAAC BRAITHWAITE & SON,
Merchants and Engineers, KENDAL.
London Agents: 3881
Pickerings, Ltd., 100c, Queen Victoria St., E.C.

ENGINEERS' CASTINGS

BRASS, GUN METAL,
PHOSPHOR BRONZE
CASTINGS
AND
INGOTS,
PHOSPHOR TIN,
"ALBION" BRAND,
BABBITT'S
METAL,
&c., &c.

ESTABLISHED 1830.

J. & J. HUGHES,
ALBION METAL WORKS,
WOODCOCK STREET,
BIRMINGHAM.

Telegrams: "Bronze," Birmingham. 3886

WEBB & SON,

TANNERS, CURRIERS, FELLMONGERS, GLOVE AND GAITER LEATHER DRESSERS, LEATHER AND WOOL MERCHANTS.

Manufacturers of

LEATHER MACHINE BANDS.

FIRE BUCKETS AND HOSE.

12 FIRST-CLASS MEDALS AWARDED.

Combs Tannery, Stowmarket.

Price Lists and Terms on Application. 1916

ROPER'S PATENT DYNAMOS

Used for the last six years with the greatest success.

GOLD MEDALS AWARDED.

Cheap, Efficient, Strong, Silent. No Sparking! No Overheating!

ILLUSTRATED CATALOGUES AND PRICES ON APPLICATION.

JOHN & Wm. ROPER, BRADFORD, Yorks.

3315

GÜLCHER ELECTRIC LIGHT & POWER COMPANY, LTD.

ARE NOW MANUFACTURING SPECIALLY FOR THE TRADE.

"BATTERSEA"

BATTERSEA MOTOR

THE GULCHER ELECTRIC LIGHT & POWER C
BATTERSEA FOUNDRY. S.W.

TRANSFORMERS
ARC LAMPS &
ELECTRICAL APPARATUS

DYNAMO.

BATTERSEA DYNAMOS.

10	Lights,	£15
15	"	£20
20	"	£25
25	"	£30

BATTERSEA MOTORS.

½	H.P.	£15
1	H.P.	£20
1½	H.P.	£25
2	H.P.	£30

3121

For Catalogue and Particulars apply to THE MANAGER, BATTERSEA FOUNDRY, S.W.

JOSEPH BOURNE & SON,

MANUFACTURERS OF THE WELL-KNOWN

STONEWARE TELEGRAPHIC INSULATORS AND BATTERY JARS.

For Thirty years these manufactures have been celebrated for a high degree of vitrefaction combined with great toughness and strength.

Brown Stoneware. White Stoneware. Brown Porcelain. Porous Cells.

Economy Strength and Durability combined. *Prize Medal, Paris Electrical Exhibition.*

Special Shapes for Telephone and Electric Lighting Wires.

Works: DENBY POTTERY, NEAR DERBY.
London Office: NEW ST. PANCRAS STATION EUSTON ROAD, N.W. 3687

TRADE MARK ROBIN HOOD R.C.&Co. B.

RAMSDEN, CAMM & CO..

BRIGHOUSE. YORKSHIRE,

Iron and Steel Wire Drawers and Galvanizers.

MANUFACTURERS OF

TELEGRAPH, TELEPHONE AND CABLE WIRE,

Contractors to H.M. Postmaster-General, the Indian and Colonial Governments and leading Railway Companies

LONDON OFFICE: 72 KING WILLIAM STREET E.C. 3246

VULCANITE.

Sheets, Rods, Tubes, Cells, &c., for Electrical Purposes.

THE NORTH BRITISH RUBBER CO., LIMITED,

Edinburgh; *London*, 57, Moorgate St.; *Manchester*, 6, Charlotte St.
Liverpool, 9, Lord Street; *Glasgow*, 106, Buchanan St;
Newcastle-on-Tyne, 39, Grainger St.; *Leeds*, 65 & 66, Briggate. 3747

ELECTRIC WIRE CASINGS.

Telephone No. 3188.

List of Sections, Prices and Discounts in all Woods free.

Mahogany and Timber Importers, Importers of School Board Flooring Blocks, Figured Wainscot Floorings, and Manufacturers of High-Class Mouldings in all woods.

Head Office: 214, PAVILION ROAD, SLOANE SQUARE, S.W.
Saw Mills: Stanley Bridge Wharf, King's Road, CHELSEA.
Branch Yard: 65a, Poland Street, Oxford Street, W. 2871

THE MIDLAND ELECTRIC WIRE CO.,

LEICESTER.

MANUFACTURERS OF

COVERED WIRES OF ALL DESCRIPTIONS

FOR BELL AND HOUSE WORK.

DYNAMO MACHINES, TELEPHONES, &c., &c.

Fancy Covered and Braided Cables and Wires.

ELECTRIC LIGHT LEADS

SILK AND COTTON COVERED WIRES.

714

COX-WALKERS

SELF-PROTECTED

ELECTRIC BELLS.

MOUNTED OR UNMOUNTED.

Are Acknowledged to be THE BEST.

COX-WALKERS

N.E. ELECTRIC WORKS, DARLINGTON.

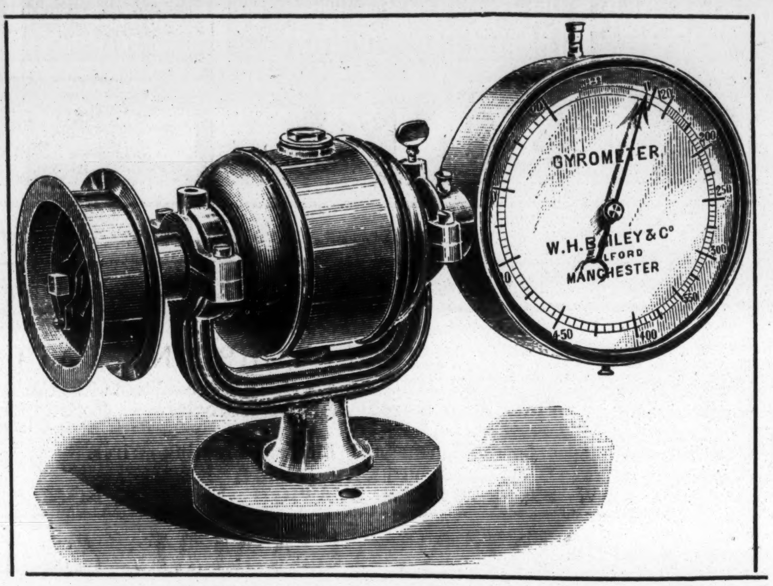
3375

BAILEY'S
"GYROMETER" OR SPEED INDICATOR

FOR USE WITH

Electrical Installations and with General Machinery.

AS MANUFACTURED BY US FOR THE BRITISH ADMIRALTY FOR WAR VESSELS.

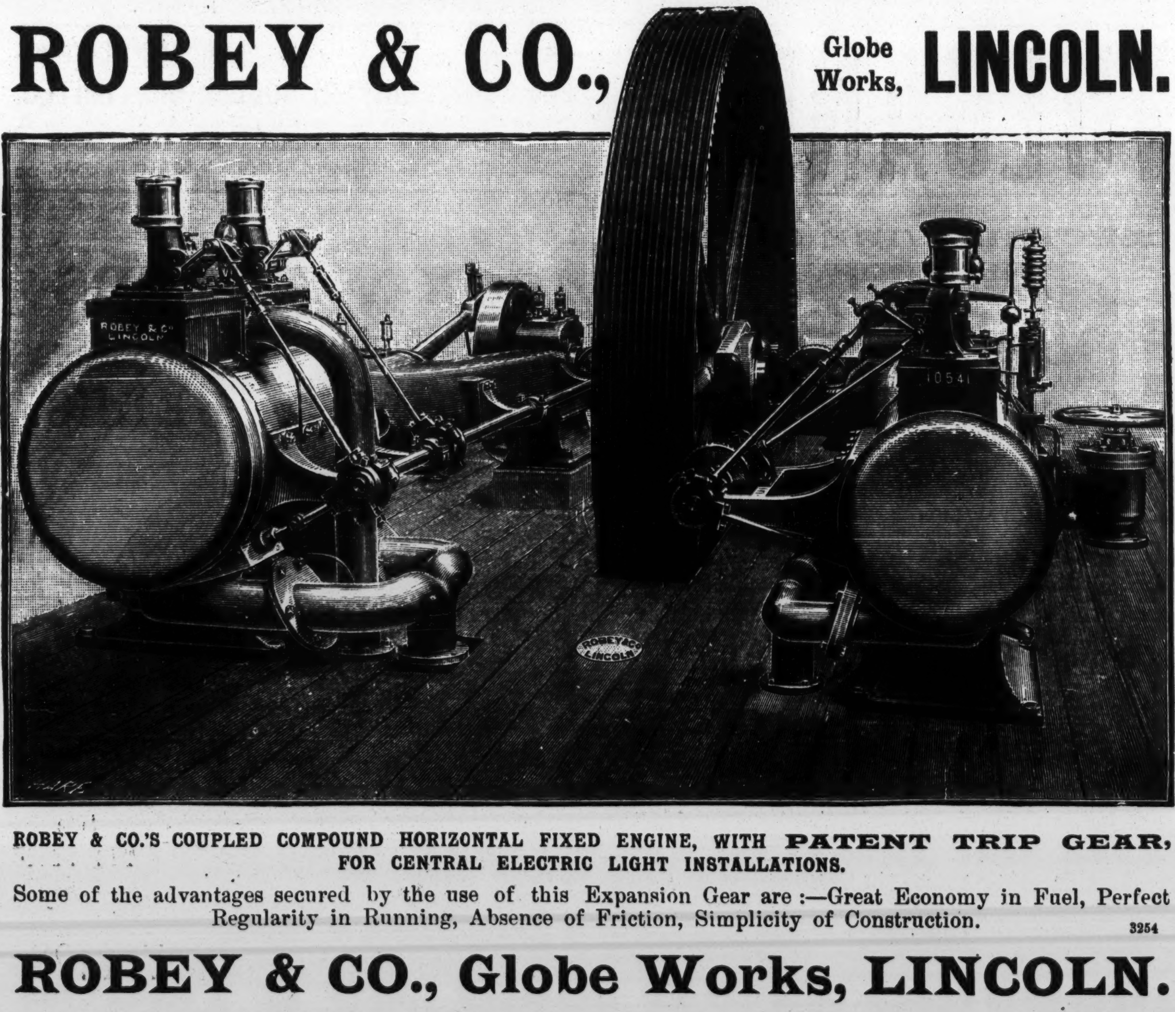


AND ALSO FOR MOST OF THE CHIEF ELECTRICAL ENGINEERS HERE AND ABROAD.

SOLE MAKERS, Diameter of Dial, 8 in.; Diameter of Pulley, 4 in. **Price £8.** 3070

W. H. BAILEY & CO., LTD., ALBION WORKS, SALFORD, MANCHESTER.

ROBEY & CO., Globe Works, LINCOLN.



ROBEY & CO.'S COUPLED COMPOUND HORIZONTAL FIXED ENGINE, WITH **PATENT TRIP GEAR,** FOR CENTRAL ELECTRIC LIGHT INSTALLATIONS.

Some of the advantages secured by the use of this Expansion Gear are:—Great Economy in Fuel, Perfect Regularity in Running, Absence of Friction, Simplicity of Construction. 3254

ROBEY & CO., Globe Works, LINCOLN.

J. G. STATTER & CO., LTD.,

ALLIANCE ENGINEERING WORKS WEST DRAYTON NEAR LONDON.

London Office: PRINCE'S MANSIONS, 68, VICTORIA ST., WESTMINSTER.

"ALLIANCE" DYNAMOS AND MOTORS for all purposes. All sizes ready for immediate delivery. Made by special machinery in the best manner possible and of the very best materials.

THE STATTER PATENT CONSTANT CURRENT DYNAMO has a higher commercial efficiency than any other, either English or American.

SPECIAL AUTOMATIC ENGINES and DYNAMOS for SHIP LIGHTING

Everything Electrical. Write for Lists. *Note to Contractors.*—Messrs. Statter do not tender for wiring jobs. *Telegrams: "Statter West Drayton."* 1931

CHEMICALS.

ALL KINDS FOR ELECTRICAL WORK, and also for INDIA-RUBBER & GUTTA-PERCHA MANUFACTURERS,

Supplied and Shipped at shortest notice by

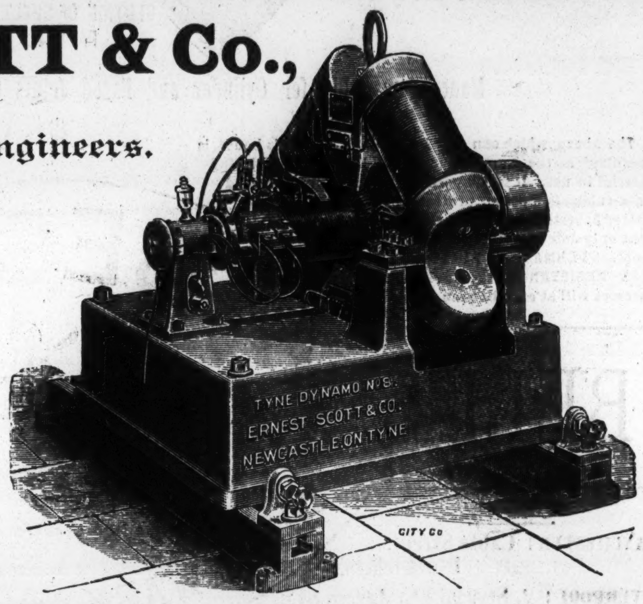
G. BOOR & Co., 1 & 2, Artillery Lane, Bishopsgate, LONDON, E.C.

CONTRACTORS TO THE POST OFFICE, WAR OFFICE, ADMIRALTY, INDIA AND NEW ZEALAND OFFICES AND LEADING TELEGRAPH COS. 2884

ERNEST SCOTT & Co.,

NEWCASTLE-ON-TYNE,

Electrical and General Engineers.



TYNE DYNAMOS,

TYNE ARC LAMPS,

TYNE TRANSFORMERS.

Complete Installations erected by experienced men at home and abroad.

SPECIAL TERMS TO THE TRADE.

Complete Catalogue on application.

Offices:	*Telegraphic Addresses:*
LONDON: 110 Leadenhall Street.	"Boltonite," London.
MANCHESTER: 24, Victoria Buildings.	"Ampère," Manchester.
HUDDERSFIELD: Lancaster Yard, Cloth Hall St.	"Dynamo," Huddersfield.
GLASGOW: 53, Waterloo Street.	"Roots," Glasgow.
NEWCASTLE-ON-TYNE: Close Works.	"Esco," Newcastle-on-Tyne.
JOHANNESBURG SOUTH AFRICA.	"Mulhause," Johannesburg.

3311

MARSHALL, SONS & Co., LTD.,

Highest Award MELBOURNE INTERNATIONAL EXHIBITION, 1889.—First Prize and Special Mention for Excellence for Engines First Prize and Special Mention for Excellence for Thrashing Machinery.

BRITANNIA IRON WORKS, GAINSBOROUGH.

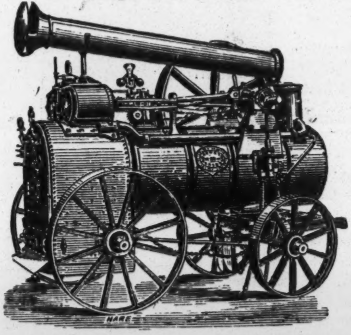
London Offices, Show Rooms & Stores:—MARSHALL'S BUILDINGS, 79, FARRINGDON Rd., E.C.

Telephone No. 6,648.

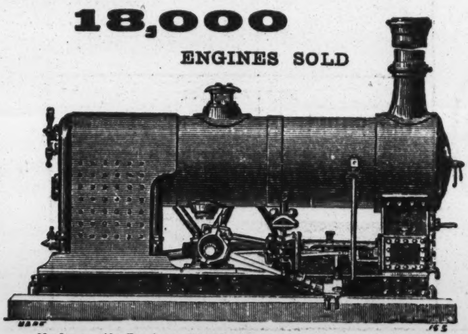
MORE THAN

18,000

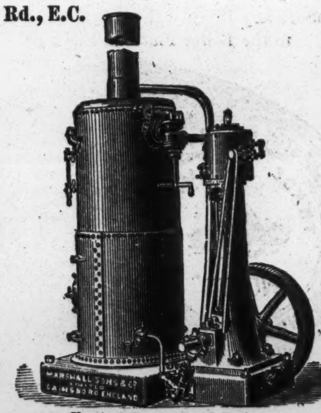
ENGINES SOLD



Portable and Semi-Portable Engines, with Automatic Expansion Gear.



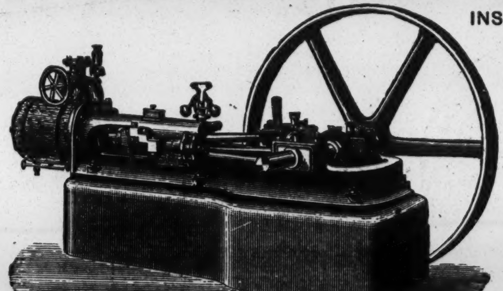
Underneath Engines, Simple and Compound, for Extreme Economy in Fuel.



Vertical Engines and Boilers.

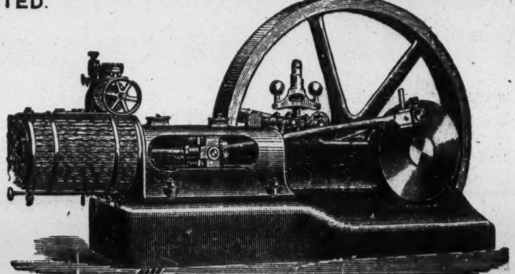
☛ M. S. & CO. KEEP A LARGE STOCK OF ENGINES &c. OF ALL SIZES AT THEIR LONDON DEPOT FOR IMMEDIATE DELIVERY ON SALE OR HIRE.

INSPECTION INVITED.



Fixed Engines, 8 to 10 H.P., with Inside Crank, for Cornish or Loco-Multitubular Boilers.

Vertical Engines for Ship Lighting and Small Installations.



Fixed Engines, with Disc Crank, Single 12 to 35 H.P., Coupled to 70 H.P. Nominal.

[*Telegrams for Works: Marshalls, Gainsboro'.*"]

New Catalogues, with Current Prices, free on application.

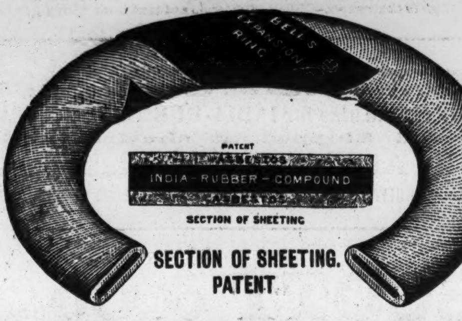
[*Telegrams for London Depôt: "Engine, London."* 2969

Gold Medal, Highest Award, Liverpool Exhibition, 1886; Gold Medal, Highest Award, Edinburgh Exhibition, 1886.

BELL'S ASBESTOS

EXPANSION SHEETING.

EXPANSION RINGS.



Made from 1-Ply for Cylinder and Faced Joints to any thickness for uneven surfaces.

The above, which can only be obtained from this house, is recognised as the **Most Efficient** and Economical Jointing Material in use. It is composed of a specially-prepared India-rubber Compound, protected by a covering of Vulcanised Asbestos Sheeting, as shown above, and as it is the only Jointing Material which adequately combines PERMANENT ELASTICITY WITH HEAT RESISTANCE, the advantages it possesses will at once be seen.

The Centre from which the requisite elasticity is obtained will adapt itself to uneven surfaces to which it may be applied, and allow the expansion and contraction to be fully taken up. The covering being of Asbestos Cloth, imparts a protection to the centre and so prolongs its elasticity. For Manhole, Mudhole, Steam Pipe, and Mash Tun Door Joints it is unequalled, and if applied as directed a ring can be used many times over.

BELL'S ASBESTOS Co., LTD.

TRADE MARK.
BELL'S ASBESTOS.
SOUTHWARK, LONDON, S.E.

DEPOTS
MANCHESTER: Cable Street, Blackfriars.
LIVERPOOL: 2, Strand St., James St.
BELFAST, DUBLIN, ANTWERP, BERLIN,

DEPOTS:
HULL: Humber Dock Basin.
GLASGOW: 35, Robertson Street.
AMSTERDAM: 264, N. Z. Voorburgwal.
BARCELONA, TRIESTE, LISBON & GENOA.

AGENTS.—BIRMINGHAM—BELL & Co., 7, John Bright Street. CARDIFF: BELL & Co., West Bute Street.

BELL'S ASBESTOS BOILER PRESERVATIVE

Will effectually keep Boilers clean and remove any Incrustation, without injury to the Boiler Plates or Fittings.

BELL'S ASBESTOS YARN & SOAPSTONE PACKING

Is the BEST LOCOMOTIVE PACKING made.

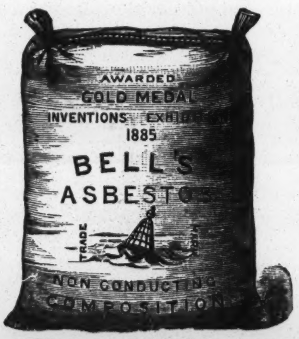
BELL'S COMPOUND HYDRAULIC PACKING

IS SPECIALLY SUITED FOR HYDRAULIC MACHINERY, ACCUMULATORS, AND AMMONIA AND ALL PUMPS.

BELL'S ASBESTOS. NON-CONDUCTING COMPOSITION.

Will reduce loss by radiation, and saves 40 per cent. of fuel.

Is sent out dry in bags therefore cheaper than others sent out wet.

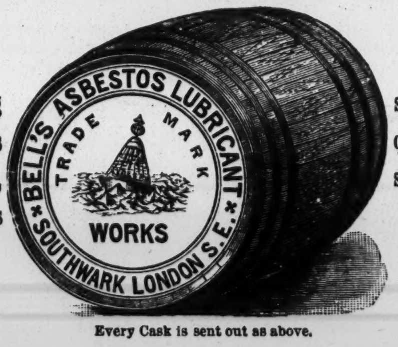


All bags are marked as above

BELL'S ASBESTOS LUBRICANT.

Any customer receiving Oil sold as Bell's Asbestos Lubricant, & Cask, Drum, or Corks not marked as shown, is earnestly requested to forward us sample and particulars of where obtained.

Drums are marked as above.



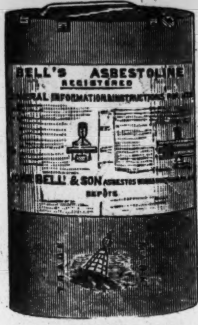
Every Cask is sent out as above.

ASBESTOS BELL'S LUBRICANT

All Corks are sealed as above.

BELL'S ASBESTOLINE.

REGISTERED.



All kegs are labelled as above.

ADVANTAGES OF ASBESTOLINE.

ASBESTOLINE is the most efficient Lubricant for all bearings.
ASBESTOLINE is the cheapest Lubricant.
ASBESTOLINE saves from 50 to 90 per cent. of the Cost of Oil.
ASBESTOLINE is the Cleanest Lubricant.
ASBESTOLINE is favoured by Insurance Companies.
ASBESTOLINE is the most Inodorous Lubricant.
ASBESTOLINE is the safest Lubricant, its flashing point being 700 F.
ASBESTOLINE has beaten all other Lubricants in making trials.
ASBESTOLINE is applicable in and out doors in every climate.
ASBESTOLINE requires no special application.

TRADE MARK.
BELL'S ASBESTOS.

CONSISTENCY OF ASBESTOLINE.

ASBESTOLINE, to meet all circumstances, is made in four degrees of consistency, A, B, C, and CC.

ASBESTOLINE A, is specially adapted to ordinary Land Engines and Machinery, in and out-door, in this country.

ASBESTOLINE B, a little more solid, is for use on Steamships in temperate climates, also on land when it is desirable to have Lubricant stiffer than A.

ASBESTOLINE C, is for use in tropical climates, both ashore and afloat. It is also invaluable in works in this country when the temperature is high.

ASBESTOLINE CC, is designed for use on calenders, paper machines, &c., where the bearings are heated by steam passing through, and sometimes is advantageously used instead of C.

The reputation of Asbestoline as a lubricant of the highest efficiency in every kind of machinery is established, and it has never been equalled by any other lubricant in the numerous cases of special difficulty in which the best oils are ineffectual. This reputation is growing daily, because it is **based on the experience of thousands of users** under the severest circumstances any lubricant has ever been subjected to, **and not on mere laboratory tests** and professional analysis of insignificant quantities. It is used with marked success in Steel and Iron Works, Collieries, Cotton and Wool Mills, and other Textile Manufactories. In Corn Mills it has proved invaluable on the roller and other modern machines. In Saw Mills, on Machines going up to 5,000 revolutions per minute, its work has never been approached by any other lubricant. On Electric Lighting Machinery, and in Steamships of all sizes throughout the world, the success of Asbestoline is unequalled. Many engines and machines of all descriptions give trouble and show bad results, both in working and wear, when the system of lubrication has not received due consideration. Engineering firms of the highest standing have given to it their powerful testimony and support.

SUPPLIED IN KEGS, 28 lbs., 56 lbs., or 112 lbs.

SPECIAL TERMS FOR LARGE QUANTITIES.

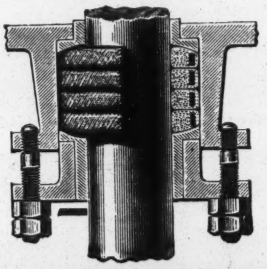
IMPORTANT TO EXPORT MERCHANTS.—One Pound of "Asbestoline" equals 2 gallons of Oil weighing 18 lbs. consequently the saving in freight is very considerable. Liberal Terms are conceded to Export Merchants.

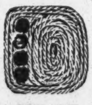
BELL'S ASBESTOS

DAGGER PACKING

DAGGER PACKING.

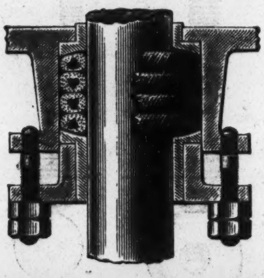
Patent.





SQUARE.

ROUND.



Every 10 feet has label as above, and bears our Trade Mark.

Under this registered title are included the inventions of Mr. Field, and experience has proved them to be **THE MOST EFFICIENT, DURABLE, AND ECONOMICAL PACKINGS** ever made. They constitute such a combination of Asbestos and India-rubber as secures the maximum of elasticity and heat-resistance, and they are therefore **UNEQUALLED FOR EVERY KIND OF ENGINE.** These Packings are being universally used by most of the leading Steamship Companies throughout the world for ordinary Compound, Triple, and Quadruple Expansion Engines of the latest type. These Packings are composed of Rolled Asbestos Cloth, but the India-rubber is placed in two forms to suit various cases.

☞ **In ordering, state whether square or round required.** ☜

BELL'S ASBESTOS COMPANY, LIMITED,

SOUTHWARK, LONDON, S.E.

**DEPOTS:—MANCHESTER: Cable Street, Blackfriars. LIVERPOOL: 2, Strand St., James St. HULL: Humber Dock Basin.
GLASGOW: 35, Robertson St. DUBLIN, BELFAST, ANTWERP, BERLIN, BARCELONA, TRIESTE, LISBON, & GENOA.
No. 264, N. Z. VOORBURGWAL, AMSTERDAM.**

AGENTS:—BIRMINGHAM: BELL & CO., 7, John Bright Street. CARDIFF: BELL & CO., West Bute Street.

2222

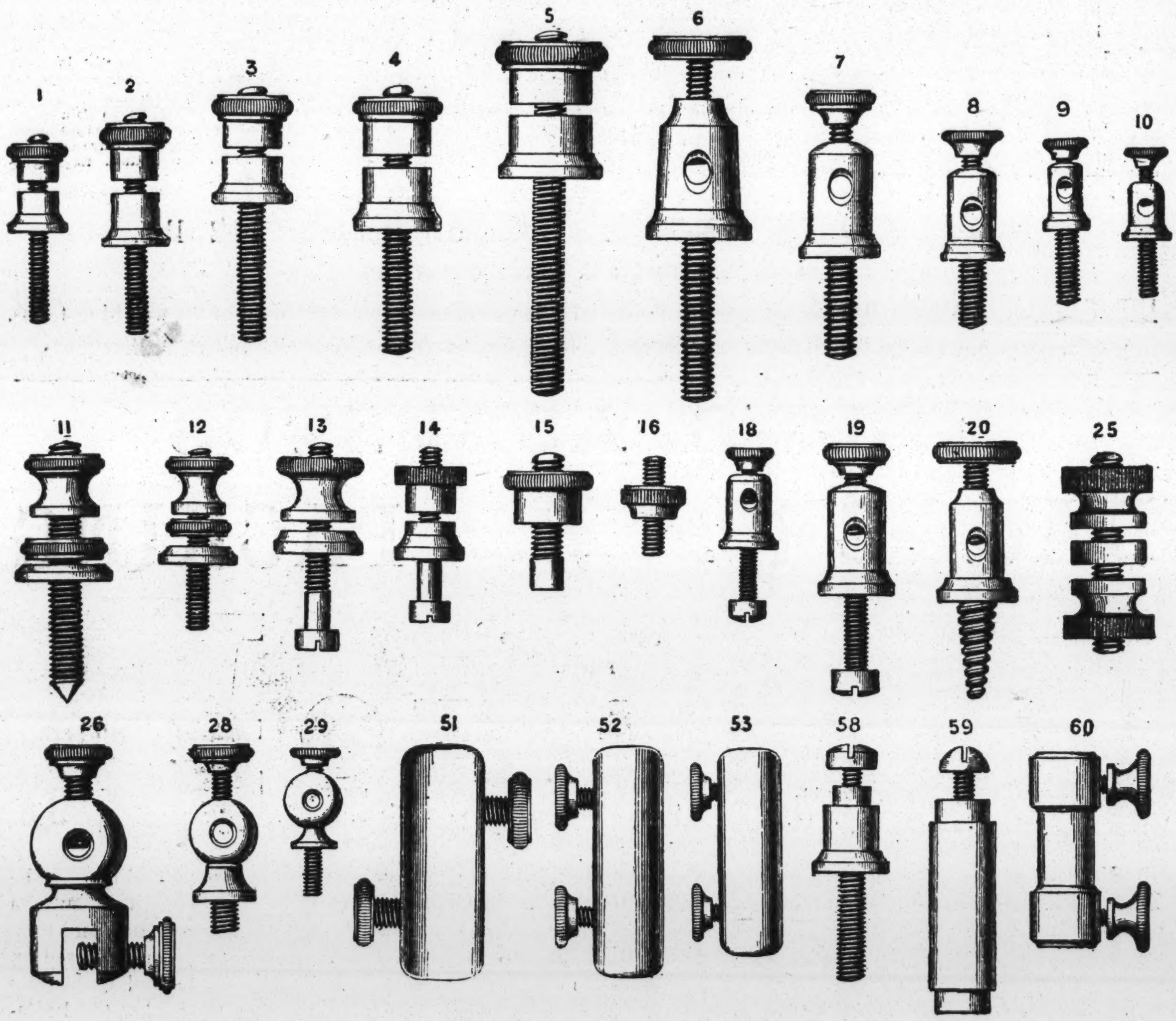
DAVIS & TIMMINS,

LIMITED,
Screw Manufacturers,
24. CHARLES ST., HATTON GARDEN,
LONDON, E.C.

TWO MEDALS

AWARDED
For Excellency of Manufactures,
PARIS INTERNATIONAL EXHIBITION, 1889.

ALL THESE GOODS ARE SHOWN FULL SIZE AND KEPT IN STOCK



SOLE AGENTS FOR J. O. MOUCHEL'S HIGH CONDUCTIVITY COPPER WIRE.

STRAIGHT DRAWN, BRASS, IRON AND STEEL, ROUND HEXAGON AND FLAT,

ALL SIZES KEPT IN STOCK.

ESTIMATES FOR SCREWS AND TURNED PARTS ON RECEIPT OF PATTERNS.

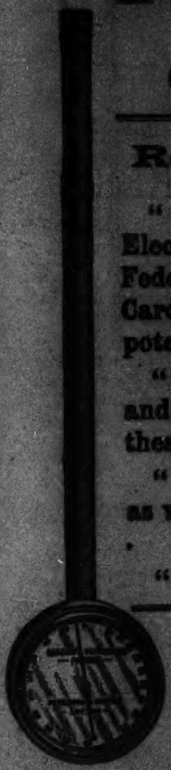
Considerable Reduction for Large Quantities. 3091

ELECTRICAL MEASURING INSTRUMENTS

PATERSON & COOPER,

ORIGINAL MAKERS OF THE

CARDEW VOLTMETER,



Cardew Voltmeter,
[illegible]

Phoenix Ammeter, [illegible]

Read Prof. WEBER'S Report.

"In the laboratories for alternating current work of the Electrotechnical part in the new Physical Institute of the Federal Polytechnical School at Zürich, I use twelve Cardew voltmeters of MM. Paterson & Cooper to measure potential differences between 20 and 1,250 volts.

"After receiving these twelve voltmeters I have made very numerous and exact measurements to get the differences between the indications of these voltmeters and the true values of the potential differences.

"The results of ALL these measurements were VERY SATISFYING, as will be seen from the following series of comparison.

. . . .

"Zürich, April, 1890. "Prof. H. F. WEBER."

Pocket Voltmeter,
[illegible]

SPECIAL TERMS TO LARGE BUYERS

Write for Price Lists of Instruments, also Dynamos, Arc Lamps, and Electric Light Requisites.

ADDRESS—

PATERSON & COOPER,
POWNALL ROAD, DALSTON, N.E.
208

Telephone No. 5422. ESTABLISHED 1870. Telegrams: "Flexible, London."

SILVER MEDAL INTERNATIONAL ELECTRIC EXHIBITION, 1882.

PHILLIPS BROTHERS,

Electricians,

OFFICES AND WORKS: THE LEA TELEGRAPH WORKS, HACKNEY WICK, LONDON E.

MANUFACTURERS OF CABLES, WIRES, &c., TO ANY SPECIFICATION.

MULTIPLE CABLES, AERIAL AND SUBTERRANEAN.

Gutta-Percha, India-Rubber, and Compound Wires of every description for Telephone and Electric Bell Work.

FANCY BRAIDED WIRES OF EVERY DESCRIPTION.

COTTON AND SILK COVERED WIRES FOR DYNAMO MACHINES, MAGNETS, &c., &c. 1177

THE SCHOOL OF SUBMARINE TELEGRAPHY
AND
ELECTRICAL ENGINEERING

ESTABLISHED IN 1868.

12 PRINCES STREET, HANOVER SQUARE, LONDON, W.

Manager:—Wm. LANT CARPENTER, B.A., B.Sc., F.C.S.
Secretary:—LEON DRUGMAN, A.S.T.E.
Senior Instructor:—CHAS. CAPITO, M.I.M.E., M.S.T.E. and E.

THIS Establishment is now the largest and the most fully equipped School of its kind. It possesses, among recent additions, several Dynamo Machines and Electric Motors, a 6-horse Boiler and Steam Engine, a Gas Engine, 42 E.P.S. Accumulator Cells, Lathes, &c., as well as several kinds of Arc and Incandescence Lamps and a Photometer Room. Both Theoretical and Practical Training can therefore be obtained. Since its opening in 1868 more than 3,000 Pupils have passed through the School. At the end of the course of instruction, an Examination for the CERTIFICATE OF THE SCHOOL is conducted by an Examiner of high standing, unconnected with the School. New Courses usually commence early in January, May, and September.

For full prospectus, terms, &c., apply to the Secretary, 12, Princes Street, Hanover Square, W. 21

INDIA-RUBBER, GUTTA-PERCHA, & TELEGRAPH WORKS COMPANY, LIMITED.

Offices and Warehouses: 106 & 100, CANNON STREET, LONDON, E.C.
Works: Silvertown, Essex; Persan-Beaumont, France.

TELEGRAPH ENGINEERS AND MANUFACTURERS
OF

CABLES.—Submarine, Subterranean, and Aerial.

WIRE.—India-Rubber and Gutta-Percha covered in all gauges.

INSTRUMENTS.—"Morse" Inkers, Single Needle, Wheatstone's Alphabetical, Semaphore "Block" Instruments, Bells, Resistance Coils, Sir W. Thomson's, and other Galvanometers, Condensers, Testing Instruments, &c.

BATTERIES.—SOLE MANUFACTURERS FOR GREAT BRITAIN, IRELAND, AND THE COLONIES OF THE CELEBRATED LECLANCHE BATTERY, which has received the most favourable reports from the Postal Telegraph Authorities and other eminent Telegraph Engineers, and is now in general use by the Post Office and English and Continental Railways. As a Battery for all Telegraphic purposes it is undoubtedly pre-eminent. All other kinds of Batteries also manufactured. Ebonite Cells, Carbon Plates, &c.

INSULATORS.—Ebonite, Porcelain, Brownware, &c.

MANUFACTURERS OF THE MOST IMPROVED APPARATUS FOR **RAILWAY BLOCK SIGNALLING.**

SEMAPHORE REPEATERS, LIGHT" INDICATORS, AND WALKER'S "PASSENGER AND GUARD" COMMUNICATOR.

TELEGRAPH STORES AND APPARATUS OF EVERY DESCRIPTION.

TORPEDO APPARATUS.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY (Limited) are Patentees and Manufacturers of a Complete System of Torpedoes for Harbour and Coast Defence,

AND OF THE

SILVERTOWN PATENT FIRING BATTERY.

A Constant Battery for Mining and Blasting Purposes.

CONTRACTS ENTERED INTO for the SUPPLY, CONSTRUCTION, and MAINTENANCE of TELEGRAPH LINES.

MANUFACTURERS OF

VULCANISED INDIA RUBBER.

VALVES SHEET, BUFFERS, SPRINGS WASHERS WHEEL TYRES CORD TUBING, AND DOOR AND CARRIAGE MATS.

INDIA RUBBER AND CANVAS SUCTION AND DELIVERY HOSE.

INDIA RUBBER and CANVAS STEAM PACKING—ROUND, SQUARE, and SHEET.

INDIA RUBBER MACHINE DRIVING BANDS.

WATERPROOF GARMENTS AND FABRICS:

Coats, Capes, Leggings, Hats, Helmets, Knee Wrappers, Diving Dresses, Sheeting for Hospitals, Water and Air-Proof Beds, Pillows, Cushions, Bottles, Baths, Life Belts, Gas Bags.

EBONITE.

Not affected by Vinegar or Hydrochloric or Acetic Acid.

Pumps.
Photographic Articles.
Speaking Tubes, Mouthpieces.
Battery Cells.
Sheet and Rod.
Surgical Appliances.

GUTTA-PERCHA.

Tubing, Belting, Buckets, Bosses for Flax Spinning, &c.

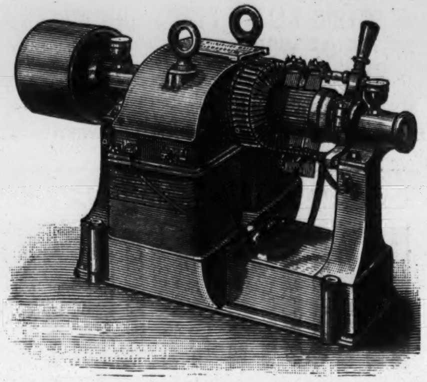
Works: SILVERTOWN, ESSEX, LONDON, E.; PERSAN-BEAUMONT, FRANCE.
London Office—106, CANNON STREET, E.C.
Warehouse—100, CANNON STREET, E.C.

BRANCH WAREHOUSES:

BOOTLE	70, Regent Road.
LIVERPOOL	52, Castle Street.
GLASGOW	8, Buchanan Street.
BRADFORD YORKSHIRE	85, Kirkgate.
SHEFFIELD	64a, High Street.
PORTSMOUTH	49, High Street.
BELFAST	33, High Street.
DUBLIN	15, St. Andrew Street.
BRISTOL	2, Clare Street.
NEWPORT, MON.	32, Dock Street.
CARDIFF	Pierhead Chambers, Bute Docks.
NEWCASTLE-ON-TYNE	6, Neville Street.
NORTH SHIELDS	Borough Road.
BIRMINGHAM	Cobden Buildings, Corporation Street.
MANCHESTER	4, Fountain Street.
LEEDS	9, Trinity Street.

216

Printed by E. KNIGHT, 18 and 19, Middle Street, E.C., and Published by the Proprietors, H. ALABASTER, GATEHOUSE & Co., at 22, Paternoster Row, London.



THE ACME ELECTRIC WORKS,

(ARTHUR C. COCKBURN, M.I.E.E., Manager.).

Supply Department and Head Office: PRINCES ST., HANOVER SQUARE, W.

Factory: FERDINAND STREET, CHALK FARM ROAD, N.W.

SOLE AGENTS FOR

ROYCE'S DYNAMO

FOR LONDON AND 54 MILES ROUND.

MAKERS OF MAIN SWITCHBOARDS.

Sole Manufacturers of Rooper's Patent Lampholder for High Candle-Power Lamps.

MAKERS OF AYRTON & PERRY'S SPRING AMMETERS AND VOLTMETERS.

Cockburn's Patent Switches and Cut-Outs and Electric Light and Telegraph Apparatus of all kinds. 2987

PRICE LSTS ON APPLICATION.

THE

INDIA RUBBER, GUTTA PERCHA, & TELEGRAPH WORKS

COMPANY, LIMITED.

Offices: 106, CANNON STREET, LONDON, E.C.

MANUFACTURERS OF

DYNAMO MACHINES,

INSULATED ELECTRIC LIGHT WIRES AND CABLES,

Lamp Fittings, Switches and Testing Apparatus, Volt and Ampere Meters.

CONTRACTORS FOR THE SUPPLY AND FITTING UP OF

ELECTRIC LIGHT APPARATUS

OF EVERY DESCRIPTION.

INSTALLATIONS FOR CENTRAL STATIONS, SHIPS, HOUSES, OR FACTORIES.

ESTIMATES ON APPLICATION.

Works: SILVERTOWN, LONDON, E. 839

THE

LONDON ELECTRIC WIRE COMPANY,

ANCHOR WORKS, PLAYHOUSE YARD, GOLDEN LANE, LONDON E.C.

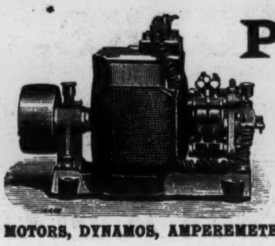
Manufacturers of

COVERED WIRES & CABLES

OF ALL DESCRIPTIONS

FOR ELECTRICAL INSTRUMENTS, ELECTRIC LIGHTING,

BELL AND TELEPHONE WORK, &C. 777



PRICE, TALBOT & CO., Ltd.,

26, LUDGATE HILL, LONDON, E.C.,

ELECTRICAL ENGINEERS, PNEUMATIC AND ELECTRIC BELL FITTERS AND MAKERS TO HER MAJESTY'S OFFICE OF WORKS.

Sole Agents and Manufacturers of McClellan's Patent Continuous Action Bells and Relays.

CATALOGUES AND ESTIMATES FREE. 3681

MOTORS, DYNAMOS, AMPEREMETERS, VOLTMETERS, and all APPARATUS connected with ELECTRIC LIGHTING SUPPLIED ON SHORTEST NOTICE.

INSULATORS

TERMINAL
SCREW BOLT
CEMENTED
SHACKLES.

STAY RODS,
SADDLES,
BRACKETS,
BOLTS.

IRONWORK

TELEGRAPH,
TELEPHONE,

BATTERIES

AND ALL
SUPPLIES.

Round, Flat,
Laminated,

DYNAMO WIRES

Lapped,
Braided.

THE TELEGRAPH MFG. CO., LD.,

HELSBY, NEAR WARRINGTON; AND 11, QUEEN VICTORIA ST., LONDON, E.C. 3127

THE GLOBE

COMPOUND ENGINE.

Simple, Economical, Durable.

STANDARD ENGINE.

STANDARD ENGINE.

USED FOR
ALL PURPOSES.

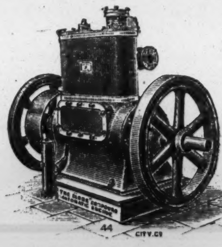
LARGE STOCK ON HAND.

All Sizes Furnished,
10 to 350 H.P.

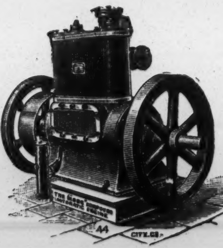
BOILERS, FEEDWATER, HEATERS, &c.

Write for Circulars.

DIRECT CONNECTED ENGINE AND DYNAMO.



STANDARD ENGINE.



STANDARD ENGINE.

JOHN MUSGRAVE & SONS,

LIMITED,

GLOBE IRON WORKS, BOLTON.

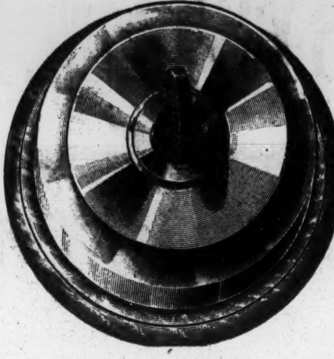
London Agents:

S. & E. RANSOME & CO., 10, Essex St., Strand, W.C.

3654

THE PAISTE SWITCH.

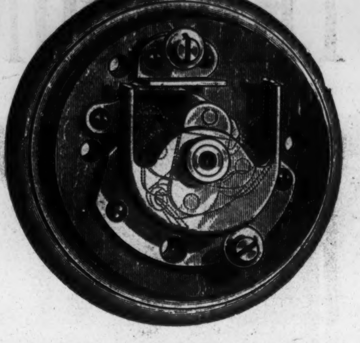
Record: 100,000 in daily use.



The movement breaks and completes the circuit in an instantaneous manner, preventing arcing or charing of the contact parts. Mounted on China, with cover and handle of same material; also on Porcelain, with metal cover. Correspondence invited.

◆◆◆◆◆◆◆

THE PAISTE SWITCH,
A. REYROLLE,
10, UNION MEWS, UNION STREET, MIDDLESEX
HOSPITAL, LONDON, W. 3566



THE
SUNBEAM LAMP CO.,
LIMITED,
GATESHEAD-ON-TYNE.

NEWCASTLE-UPON-TYNE ROYAL MINING, ENGINEERING & INDUSTRIAL EXHIBITION
18 87
QUEEN'S JUBILEE YEAR

SILVER MEDAL,
Newcastle Exhibition,
1887.

SOLE MAKERS OF
"SUNBEAM"
INCANDESCENT LAMPS

London Address:
121, FENCHURCH ST., E.C.

THESE LAMPS INFRINGE NO PATENTS.
THE SUNBEAM LAMP

200 C.P. 2,000 C.P.

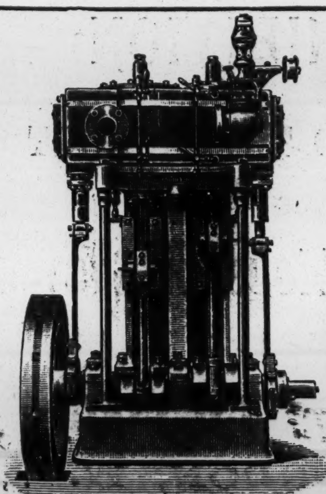
SILVER MEDAL,
PARIS EXHIBITION,
1889.

PRICES AND PARTICULARS
ON APPLICATION.

Telegraphic Addresses:
"SUNBEAM, GATESHEAD."
"CYCLOPS, LONDON."

LOW RESISTANCE.

3123



VERTICAL COMPOUND HIGH-SPEED ENGINE, C. S. TYPE.

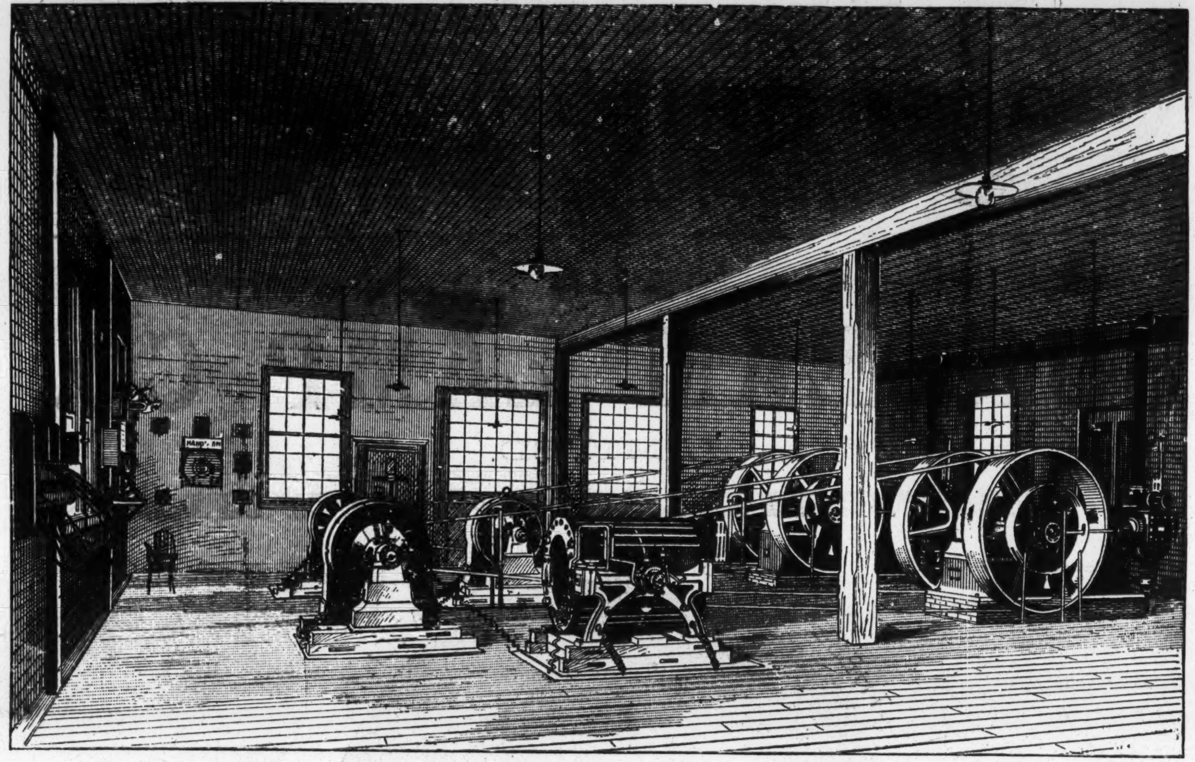
From 20 to 300 I.H.P. made.

ELECTRIC LIGHT ENGINES.
Over 150 Installations,
INCLUDING
STEAM SHIPS, WAR VESSELS, FACTORIES, MANSIONS,
AND CENTRAL STATIONS,
HAVE BEEN ENGINED BY
BROWETT, LINDLEY & CO.,
SANDON ENGINE WORKS,
SALFORD, MANCHESTER.

Patentees and Sole Makers of the ACME GOVERNOR. Hundreds are in use for Electric Light Engines. Send for Lists. 3785

THE

THOMSON-HOUSTON SYSTEM.



ALTERNATING CURRENT ELECTRIC LIGHTING APPARATUS.

The Instalment of over 150 Central Station Plants has demonstrated the Alternating Transformer System to be Superior to all others for distributing current from a Central Station over small or large areas for lighting and power purposes.

Temporary

Installations.

ELECTRICAL STORES

OF EVERY DESCRIPTION.

"Okonite" Wire

OF ONE QUALITY ONLY,

viz:—

1,000 MEGOHMS PER MILE.

Isolated Plants.

Houses Wired.

A

MODEL CENTRAL STATION.

THE

ROYAL ✦ MILITARY EXHIBITION

LIGHTED THROUGHOUT

ON THE

THOMSON-HOUSTON SYSTEM

LAING, WHARTON & DOWN,

82a, NEW BOND STREET, LONDON, W.

3275

RONALD A. SCOTT. M.I.E.E.,

CONTRACTOR TO THE LORDS OF THE ADMIRALTY,
INDIAN GOVERNMENT, &c.,

ACTON HILL ELECTRICAL WORKS, LONDON, W.

MANUFACTURER OF

DYNAMOS, MOTORS, ARC LAMPS.
SEARCH LIGHT APPARATUS of every description.
SWITCHES.
CUT-OUTS—ORDINARY, MAGNETIC.
SCOTT'S PATENT SWITCHBOARDS.
" " LAMPHOLDERS.
" " MIRRORS FOR PROJECTORS—
Unequalled.

NOTE.—Any of the above to be seen in stock at the Works, or in course of construction. The Acton Hill Works is the only Establishment in the Kingdom where Projectors of three sizes, fitted complete with lamp and mirror, can be obtained from stock.

ESTIMATES GIVEN FREE

For Wiring, Laying of Mains, or Fitting up Complete Installations with independent plant, consisting of Engines, Boilers, Accumulators, &c.

SPECIAL ATTENTION

Is drawn to the facility for supplying electrical plant at short notice, and of perfect workmanship. Owing to the possession of the most modern machinery and appliances and a trained staff urgent work can have the best attention.

✻ NOTE ✻

ELECTRICAL CONTRACTORS AND CONSULTING ENGINEERS are invited to send particulars of Specifications and Specialities required. Dynamos, Motors, and Electrical Apparatus built to Inventors' own instructions.

DON'T FORGET to inspect exhibit at the Edinburgh Exhibition. Search Light Plant operating every evening.

3674

NON-MAGNETIC

WALTHAM WATCHES

A full assortment in Key-winding and Keyless Open Face and Hunting; also ⅕th second Chronographs.

THE HIGHEST TESTIMONIALS FROM ELECTRICIANS.

Price Lists and Particulars on Application to

H. W. BEDFORD,

69, REGENT STREET, LONDON, W. 3585

"THE MOST EFFICIENT"

AND CHEAPEST

DYNAMO

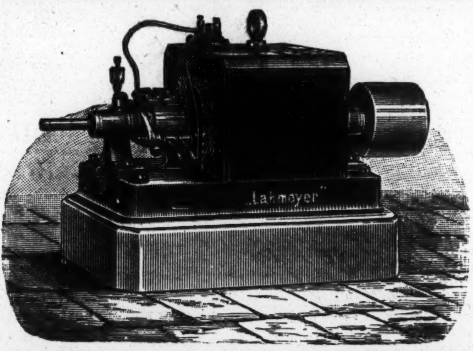
IN THE MARKET.

Our Continuous Current Patent "Lahmeyer" Dynamo cannot be excelled for perfect working and actual cost; should be seen to be appreciated.

We also manufacture a special machine for coupling direct to motor.

3513 CATALOGUE FREE.

BOLLING & LOWE, 2, Laurence Pountney Hill, LONDON.



KING, MENDHAM & CO.,

WESTERN ELECTRICAL WORKS, BRISTOL,

Manufacturers of

WIMSHURST INFLUENCE ELECTRICAL MACHINES

Of New and Improved Pattern, with and without Glass Case, double or quadruple plates. Acknowledged to be the best finished and most efficient machines in the market.

Electric Bells and Indicators, Automatic Gas Lighting Burners, K. M. B. Patent Pocket Galvanometers Deprez-D'Arsonval and other Galvanometers, Resistance Coils, Metre and Wheatstone, Bridges, Morse Sounders of special pattern, Lightning Conductors supplied and erected, and thorough efficiency guaranteed.

NEW PRICE LIST, POST FREE, 4½d. *Telegraphic Address: "KINGHAM BRISTOL."* 5061

Specially Compiled List of Electrical Publications, Post Free 2d.

THE BABCOCK & WILCOX CO.

PATENT

WATER-TUBE STEAM BOILER.

Over 500,000 H.P. in use.

Specially adapted and generally used for

ELECTRIC LIGHTING PURPOSES,

Because of their Great Economy in Fuel, Safety from Explosion, Durability; but principally their Entire Reliability.

The Edison Company have in use upwards of 10,000 H.P. of these boilers in all parts of the world. An important installation may be seen at work at the Grosvenor Gallery, London. The Societa Anglo-Romana, per l'Illuminazione di Roma, have had in use, for a considerable period, some 1,400 H.P. They may be seen, also, at work at the installation of the Societa per l'Illuminazione Elettrica, Palermo, Sicily, &c., &c. The Imperial Continental Gas Association, Vienna, is having erected an important installation of these boilers in connection with the lighting of the Grand Opera House in Vienna.

In connection with ELECTRIC LIGHTING, the reliability that can be placed on these boilers has led to their preference over others, and has ensured the large and increasing trade of the Company.

A VALUABLE BOOK ON STEAM FREE ON APPLICATION.

European Works: KILBOWIE, near GLASGOW.
Head Office for Europe: 21, Bothwell St., GLASGOW.
London Office: 114, NEWGATE STREET, E.C.

Manchester Office: 38, DEANSGATE. Paris office: 20, BOULEVARD VOLTAIRE. Brussels: 14, PLACE DE BROUCKERE, BRUSSELS.

FOR AUSTRALIA AND NEW ZEALAND, ADDRESS—

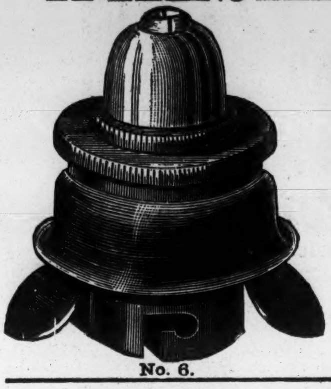
THE BABCOCK & WILCOX CO., 280, Sussex Street, SYDNEY, N.S.W. 2852

WALSALL ELECTRICAL CO.

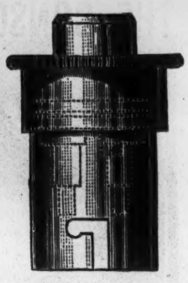
LAMPHOLDERS

UNDER LICENSE BY

THE EDISON AND SWAN COMPANY.



No. 6.



3924

ANDREWS & PREECE, LTD.,

ELECTRICAL ENGINEERS & CONTRACTORS,

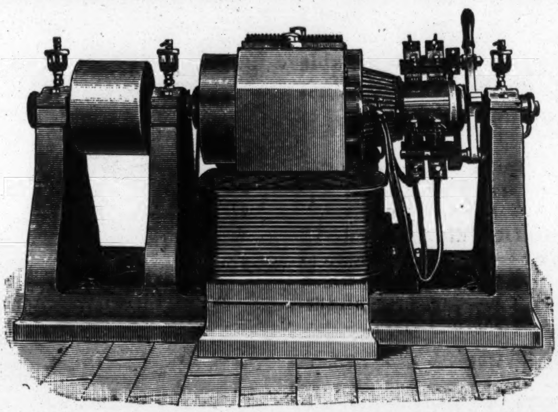
MANUFACTURERS OF THE

"PREECE" DYNAMO.

ARC LAMPS, SWITCHES, &c.

Estimates and Specifications prepared free of charge on application.

BOROUGH MILLS, MANCHESTER ROAD,
BRADFORD. 3826



Chas. CHURCHILL & CO., Ltd.,

21, CROSS STREET, FINSBURY, LONDON, E.C.,

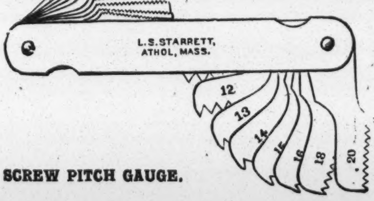
Engineers and Importers of

AMERICAN TOOLS AND MACHINERY.

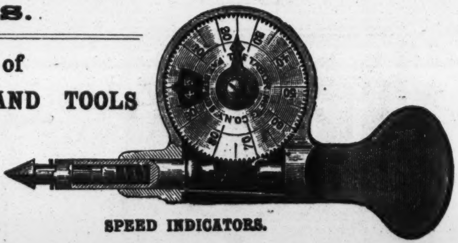
LARGE SHOW ROOMS.

The Largest Stock of
AMERICAN MACHINERY AND TOOLS
in Great Britain.

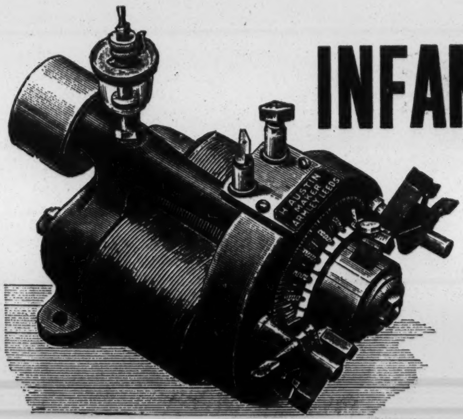
NEW CATALOGUE, 180 PAGES,
Sent for 1s. 3840



SCREW PITCH GAUGE.



SPEED INDICATORS.



AUSTIN'S

INFANT DYNAMOS & MOTORS

Specially constructed for practical working. First-class workmanship and materials. Electrically and mechanically perfect. For Lighting, Plating, Transmission of Power, &c., &c.

Size,	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6
Output in Watts - -	50	100	200	400	700	1,000
Per Cent. Efficiency	75	78	80	84	88	92

LONDON AGENTS:

Messrs. PATERSON & COOPER, Pownall Rd., DALSTON, N.E.

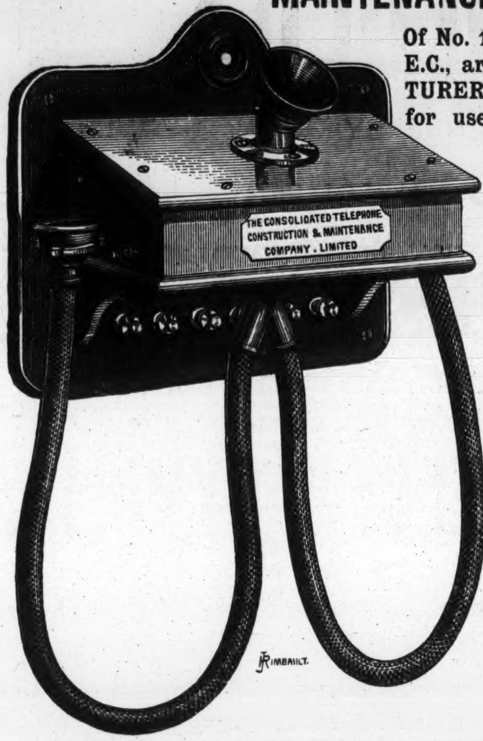
PRICE LIST AND PARTICULARS ON APPLICATION.

H. AUSTIN, Florence Electrical Works, ARMLEY, LEEDS. 3848

TELEPHONES

FOR EXPORT TO ALL PARTS OF THE WORLD.

THE CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE CO., LTD.,


THE CONSOLIDATED TELEPHONE CONSTRUCTION & MAINTENANCE COMPANY, LIMITED
J. RIMBAULT.

Of No. 109, FARRINGDON ROAD, LONDON, E.C., are the SOLE LICENSED MANUFACTURERS of TELEPHONES for Export and for use in the United Kingdom, under LICENSE granted to the Company by the UNITED TELEPHONE CO. of London (now the NATIONAL TELEPHONE CO.)

NO TELEPHONES can be manufactured by any person or Company (other than the CONSOLIDATED TELEPHONE CO.) in the United Kingdom, and the said Company offer a substantial reward for sufficient evidence as will enable proceedings to be taken against infringers of these rights.

Catalogues and Price Lists are to be had Free on application.

The CONSOLIDATED TELEPHONE CO. is prepared to supply the celebrated SIMPLEX ARC LAMP, which burns with great brilliancy and steadiness in parallel circuits.

Sizes from 5 Ampères Upwards.

SINGLE LAMP COMPLETE, WITH GLOBE (large and small size) from 90s.

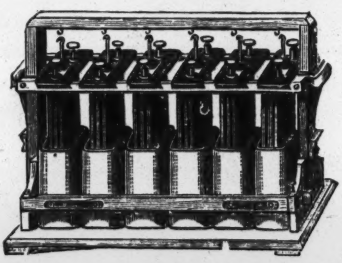
J. ORME & CO.,

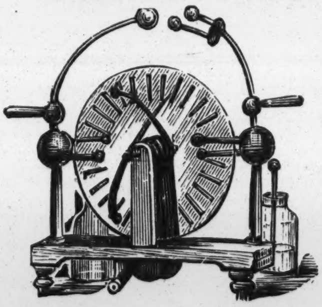
MANUFACTURERS OF EVERY DESCRIPTION OF

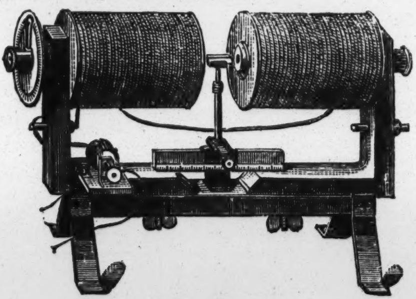
APPARATUS FOR USE IN TEACHING OR EXPERIMENTING IN THE SCIENCES OF CHEMISTRY, ELECTRICITY, MAGNETISM ACOUSTICS, LIGHT, HEAT, HYDROSTATICS, MECHANICS, &c.

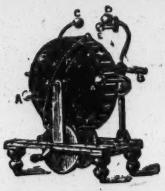
IMPORTERS OF FINEST BOHEMIAN GLASS, BERLIN PORCELAIN, PURE CHEMICALS FOR ANALYSIS &c.

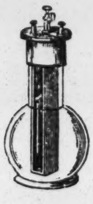
ELECTRIC BELLS AND BATTERIES.

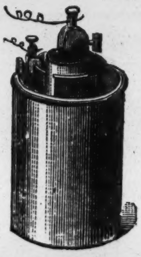












Apparatus for Science Classes supplied through the Science and Art Department at 50 per cent. reduction of prices.

ILLUSTRATED PRICE LIST OF ELECTRICAL APPARATUS. POST FREE, THREE STAMPS.

Price List of Chemical Apparatus with 650 Illustrations, post free eight stamps.

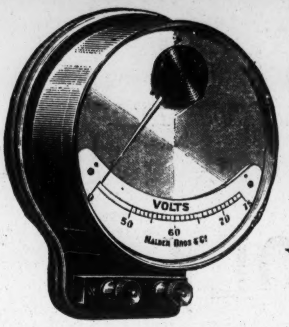
TRADE TERMS AND SPECIAL QUOTATIONS FOR EXPORT SENT ON APPLICATION.

205

J. ORME & Co. (Late M. Jackson & Co.), 65, Barbican, London, E.C.

TELEPHONE, No. 3120. Telegraph Address: "SECOHM, LONDON.

NALDER BROS. & CO.,



MANUFACTURERS OF

TESTING INSTRUMENTS,

AMMETERS

AND

VOLTMETERS.

A SPECIALITY IN HIGH-CLASS

SWITCH, FUSE & DISTRIBUTION BOARDS

FOR DIRECT OR ALTERNATING CURRENTS.

RESISTANCE FRAMES,

SINGLE, DOUBLE & TREBLE POLE SWITCHES.

NALDER BROS. & Co.,

132, HORSEFERRY ROAD, WESTMINSTER. 3556

M. HOLROYD SMITH,

Crossley Street, HALIFAX, and 18, Abingdon St., WESTMINSTER,

ENGINEER DURING CONSTRUCTION OF

THE BLACKPOOL ELECTRIC TRAMWAY,

AND PATENTEE OF THE SYSTEM.

Contracts undertaken for equipping and working Railways or Tramways with Electricity by means of **UNDERGROUND CHANNELS, OR OVERHEAD CONDUCTORS.**

3850

J. F. & G. HARRIS, Manufacturers to the Trade.

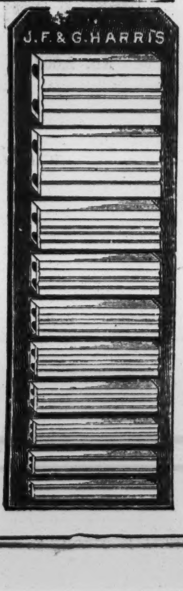
ELECTRIC LIGHT CASINGS

OVER 150,000 FEET, ready for immediate delivery, **IN STOCK.**

COVERS AND CASINGS MADE TO ANY DESIGN.

J. F. & G. HARRIS.
MAHOGANY & GENERAL
TIMBER MERCHANTS
AND
MOULDING MANUFACTURERS.

OFFICES AND MILLS,
58 & 60, WILSON STREET, FINSBURY, E.C.
ORANGE STREET, GRAVEL LANE, SOUTHWARK, S.E.
VICTORIA WHARF, TWIG FOLLY BRIDGE, BETHNAL GREEN E.
LONDON.



Special Quotations for Large Quantities. Sample Board, Catalogues and Price Lists forwarded on application. 2953

ALL ENGINEERS and CONTRACTORS should have our SAMPLE BOARD. It is recognised as the most complete yet issued.

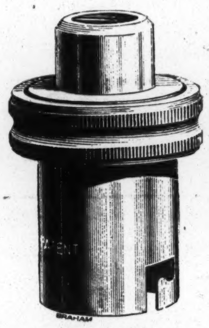
Chapel Street, SALFORD, MANCHESTER; 7, Bothwell Street, GLASGOW.

71, QUEEN VICTORIA STREET,
LONDON, E.C., *July 30th, 1890.*

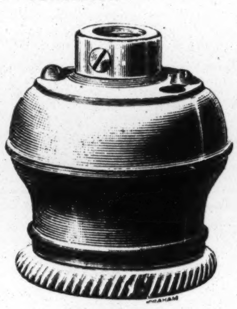
LAMPHOLDER MONOPOLY.

NOTICE.

Having investigated the claims of the Edison-Swan United Electric Light Company to patent rights for the manufacture of Lampholders in the United Kingdom, we have come to the conclusion that these claims cannot be contested successfully. We have, therefore, made an arrangement with the above-named Company to protect our Customers against law suits for infringement on all Lampholders which we have hitherto sold to them, and have secured a LICENSE under which we shall manufacture our Lampholders for the future. This License stipulates for the following



No. 2,001.



No. 2,061.

PRICES

For **STANDARD LAMPHOLDERS**	(No. 2,001)		1/8	each.
Do. with **SHADE CARRIER**		- - -	2/1	„
Do. with **CORD GRIP** and **SHADE CARRIER**			2/6	„
ACORN SOCKETS	(No. 2,061)	- - -	2/-	„
KEY „	(No. 2,071)	- - -	4/-	„

Less discount to the Trade.

For prices of our other Holders, refer to our new Catalogue which will appear about August 15th.

No. 2,003.

No. 2,071.

We are continually stocking large quantities of these Holders, and our endeavour will be to keep up the quality of the Holders to a first-rate standard.

THE GENERAL ELECTRIC CO., LTD.,

G. BINSWANGER, *Managing Director.*

MANUFACTURERS AND SUPPLIERS OF ELECTRIC LIGHT FITTINGS AND SUNDRIES TO THE TRADE.

THE "CASTLE" DYNAMOS AND MOTORS

SLOW SPEED HIGH EFFICIENCY BEST WORKMANSHIP

PATENT ARC LAMPS, SWITCHES ETC. J. H. HOLMES & Co.,
NEWCASTLE-ON-TYNE
& 74, Coleman Street, LONDON, E.C.
[illegible]

WOODHOUSE & RAWSON UNITED, LD., See Page xi. 3671

TELEPHONE: 1583. TELEGRAMS: "INDICES," LONDON.

WHEATLEY KIRK, PRICE & GOULTY,
(Established 1850),
ELECTRICAL AUCTIONEERS, VALUERS
AND ARBITRATORS,
52, QUEEN VICTORIA STREET, LONDON, E.C.,
And Albert Square, MANCHESTER. 1542

FOR SALE BY TENDER.

Lundy Cable Company, Limited, in Liquidation.

THE WHOLE of the CABLE, LAND LINES and PLANT belonging to the above company, consisting of the following: The cable as it now lies (broken) between Lundy and Hartland Point; length about 11 nautical miles. Shore ends 3 nautical miles, or thereabouts, served with tarred jute and closed over all with 12 strands each of three No. 5 galvanised steel wires, the whole weighing about 16 tons per mile. Main cable, 8 nautical miles, or thereabouts, closed over all with 15 No. 5 galvanised steel wires, and three coatings of pitch compound alternately with two servings of jute yarn in opposite directions, the whole weighing about 9 tons per mile. About 3 miles of spare cable in Swansea. Circular cable tank of wrought iron, 25 feet diameter and 4 feet deep. Paying out and picking up machinery, buoys, ropes, tackle, &c., as originally used for laying and repairing the said cable, and sundry other small stores. About 5 miles of landline in Devonshire.

Tenders sealed and marked "Tender for Lundy Cable, &c.," to be forwarded to the Liquidator, HERBERT J. GOSS, F.C.A., Chartered Accountant, at his office, 59, Wind Street, Swansea, on or before the 21st August inst., to whom all enquiries should also be addressed. The Liquidator does not bind himself to accept the highest or any Tender. 3923

THE ELECTRIC & GENERAL INVESTMENT CO.,
LIMITED,
Offices:—1 & 2, GREAT WINCHESTER STREET, LONDON, E.C.

His Grace the DUKE OF MARLBOROUGH, Chairman.

The Company has been formed FOR THE PURPOSE OF FACILITATING THE PROMOTION AND DEVELOPMENT OF UNDERTAKINGS for Electric Lighting, Traction, Transmission of Power, and other industrial uses of electricity.

Communications may be addressed to—
J. CECIL BULL,
Secretary.
3827

ENGRAVED NAME PLATES
MACHINE ENGRAVING
ON BRASS, IVORY, EBONY, &c.,
TO THE TRADE.
GILKES' ENGRAVING WORKS, READING, BERKS
3895

VULCANITE.
HARBURG INDIA-RUBBER COMB COMPANY.
London Warehouse: F. WINTER,
138, LONDON WALL WOOD STREET E.C.
EBONITE. 1710

CHEAP PREPAID ADVERTISEMENTS,

Relating to *Situations Vacant, Situations Wanted, Businesses Wanted, Businesses for Sale, Patents for Sale, Specific Articles of any kind Wanted, or for Sale or Exchange, are inserted at the rate of* ONE PENNY *Per Word (minimum 1s.).*

Three consecutive Insertions for the Price for Two.

*** This Scale does not apply to Trade Advertisements, terms for which can be had on application.

ELECTRICAL ENGINEER.—PARTNER WANTED, able to push for orders and take charge of installation work. Capital required, £1,500 to £2,000. New works; new specialities. Excellent start for energetic young man.—Apply, stating experience and qualifications, No. 3,917, Office ELECTRICAL REVIEW. 3917

WANTED.—A Traveller for first-class London installation work. Small salary and good commission. Apply in first case by letter to "S," 66, Victoria Street, S.W. 3922

WANTED, Situation by a young man (19) used to resistance coil work.—"J.," 42, St. Paul's Crescent, N.W. 3918

MECHANICAL AND ELECTRICAL ENGINEER (Age 25), desires engagement; used to dynamos, wiring and erecting plants. Home or abroad.—Address "C," 36, Oakley Crescent, Chelsea, S.W. 3921

WANTED.—A Capitalist to join the inventor to manufacture and put on the market a high pressure continuous dynamo.—ALPHA, 5, Brightside Bank, Sheffield. 3926

FOR SALE.—52 "L 23" E.P.S. Cells in glass boxes, 1888 type, complete with insulators, trays, and glass covers; substantial oak frames, shellac varnished. Have had six months' use, and are in good order. Price £125 net.—Apply, SHARP & KENT, Engineers, 34, Victoria Street, Westminster. 3927

FOR SALE.—DYNAMO, new, 20 ampères 55 volts. £16.—MARPLES, 258, Euston Road.

SECOND-HAND ALTERNATORS—both self-exciting and for separate exciters. Sections may be connected in series or parallel at will, thus affording wide range of E.M.F. and currents.—For full particulars apply ELECTRICAL ENGINEERING CORPORATION, 68, Victoria Street, Westminster. 3366

FOWLER, LANCASTER & CO., LTD.,
BIRMINGHAM,
IS NOW THE
LARGEST MANUFACTORY IN THE KINGDOM
FOR ALL
ELECTRICAL SUPPLIES.
2062

CITY AND GUILDS OF LONDON INSTITUTE

For the Advancement of Technical Education.

President:—H.R.H. the PRINCE OF WALES, K.G.
Chairman of Council:—The Right Hon. the EARL OF SELBORNE, F.R.S.

SESSION 1890-91.

Matriculation or Entrance Examinations will be held on September 22-24th, for the Central Institution, and on September 30th, for the Day Department of the Technical College, Finsbury.

CENTRAL INSTITUTION.

THE COURSES of Technical Instruction at the Central Institution of the City and Guilds of London Institute are adapted to the requirements of persons who are preparing to become Civil, Mechanical, or Electrical Engineers, Chemical and other Manufacturers and Teachers.

MATHEMATICAL DEPARTMENT under the direction of Professor Henrici, F.R.S.

ENGINEERING DEPARTMENT under Professor Unwin, F.R.S., M.I.C.E. (Dean of the Institution).

PHYSICAL AND ELECTRICAL DEPARTMENT under Professor Ayrton, F.R.S.

CHEMICAL DEPARTMENT under Professor Armstrong, Ph.D., F.R.S.

The NEW SESSION commences on SEPTEMBER 30th. The Entrance Examination will be held on September 22nd to 24th.

Programme and full particulars of Courses of Instruction, and of the Entrance Scholarships, on application at the Central Institution, Exhibition Road, or at the office of the Institute, Gresham College, E.C.

TECHNICAL COLLEGE, FINSBURY.

Day Department for Students not under 14 years of age.

THE DAY CLASSES at the City and Guilds of London Technical College, Finsbury, provide Technical Instruction for Mechanical and Electrical Engineers and Technical Chemists, and are under the direction of Professor S. P. Thompson, D.Sc., Principal of the College, Professor J. Perry, F.R.S., and Professor R. Meldola, F.R.S.

The NEXT SESSION commences on October 7th. The Entrance Examination will be held on September 30th.

For further particulars of Day and Evening Classes, Scholarships, &c., apply at the College, Leonard Street, City Road, E.C., or at the office of the Institute.

JOHN WATNEY, *Hon. Sec.*

City and Guilds of London Institute,
Gresham College, E.C.

3925

NOTICE TO CREDITORS.

In the matter of the Volta Electrical Company, Limited, Electrical Engineers and Contractors, Circus Street, Piccadilly, Manchester.

NOTICE IS HEREBY GIVEN that the creditors of the above-named company are required, on or before the 19th day of September, to send their names and addresses, and the particulars of their debts or claims, and the names and addresses of their solicitors, if any, to Mr. THOMAS BROWETT, Sandon Iron Works, Salford, Manchester, the undersigned liquidator of the said company, and, if so required, by notice in writing from the said liquidator, are by their solicitors, to come in and prove their said debts or claims at such time and place as shall be specified in such notice, or in default thereof they will be excluded from the benefit of any distribution made before such debts are proved.

Dated this 8th day of August, 1890.

3916 THOMAS BROWETT, *Liquidator.*

"INSTRUCTIONS FOR THE LAYING AND JOINTING OF UNDERGROUND ELECTRIC CABLES."—Profusely Illustrated.—Translated from the French of Dr. Francois Borel. The KINETIC ENGINEERING Co., 26, Norfolk Street London, W.C.

613

OWENS COLLEGE, MANCHESTER.

ELECTRICAL TECHNOLOGY.

A SPECIAL course has been arranged on the Technical Applications of Electricity.

A dynamo house has recently been built in connection with the physical laboratory, containing a 7 H.P. Otto gas engine, two direct and two alternate current dynamo machines, specially constructed for purposes of instruction, &c.

In the laboratory full instruction is given in electric and magnetic measurements, testing of dynamos, &c. The session begins October 7th.

For prospectus, apply to the Registrar.

3907 H. W. HOLDER, M.A., *Registrar.*

TRAINING FOR ELECTRICAL ENGINEERS.

THE ELECTRICAL STANDARDISING, TESTING AND TRAINING INSTITUTION,

FARADAY HOUSE, CHARING CROSS ROAD, LONDON, W.C

BOARD OF CONTROL.

The RT. HON. the EARL OF CRAWFORD, *Chairman.*
The HON. REGINALD BROUGHAM.
ROBERT HAMMOND.
FRANCIS INCE.

PRINCIPAL.

HUGH ERAT HARRISON, B.Sc., A.M.I.C.E.

THE NEXT SESSION will commence on WEDNESDAY, 17th September. The Institution is in affiliation with some of the largest Electricity Supply Companies, into whose works and stations the Students are drafted.

Application should be made to the Secretary, P. A. LATHAM, M.A., 15, St. Helen's Place, E.C.

3890

PHŒNIX FIRE OFFICE

(*ESTABLISHED* 1782.)

CHIEF OFFICE:—19, LOMBARD STREET, E.C.
WEST END OFFICE:—57, CHARING CROSS, S.W.
LONDON.

WILLIAM C. MACDONALD.
FRANCIS B. MACDONALD. } *Joint Secretaries.*

Losses paid over £17,000,000.

ELECTRIC LIGHTING.—16th Edition of the PHŒNIX FIRE OFFICE RULES for installations are up to date and in universal use.

*** *These Rules are Copyright.*

2959

WILLIAM WOOD & CO.,

ALBERT STREET WORKS, BURSLEM

MANUFACTURERS OF

CHINA AND PORCELAIN SWITCHES,

Screwed and Plain,

SUSPENDERS, CEILING ROSES, BASES,

LAMPHOLDERS, CUT-OUTS

2804

AND ALL CHINA FITTINGS USED BY ELECTRICIANS

Telephone No. 11,147.
Samples and Quotations on receipt of Patterns and Specifications.

R. McGOUNE, BUCHANAN & CO.,

Wholesale Mica Merchants. Mica for Electrical and all other purposes.

9, MINCING LANE, LONDON. E.C.

Telegrams, "Boulanger."
Special Department for Chemicals used by Electricians.

TRADE MARK.

FOWLER LANCASTER & Co LIMITED
ENERGY
BIRMINGHAM

ELECTRICAL SUPPLIES.

CHINA.

15,000 Lamp Holders,
3,000 Shade Holders.
5,000 Cut-Outs,
6,000 Ceiling Connectors,
700 Wall Connectors,
13,000 Branch Switches,
3,000 Main Spring Switches, assorted sizes,

STOCKED READY FOR IMMEDIATE DELIVERY.

2862

FOWLER, LANCASTER & CO., LTD., BIRMINGHAM.

Telephone No. 3125.

SHARP & KENT,
34, VICTORIA STREET,
WESTMINSTER, AND BRANCHES.

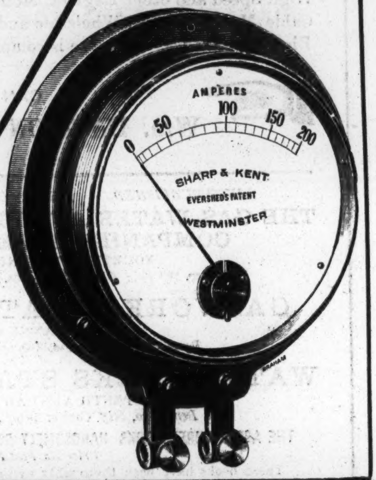
NEW PRICE LIST NOW READY.

AMMETERS
and
VOLTMETERS

For Engine Room use,
Alternating or
Direct Current.

MARINE TYPE
For Ship,
Tram,
Train use.

Telegrams:
"MEGAVOLT,"
LONDON.

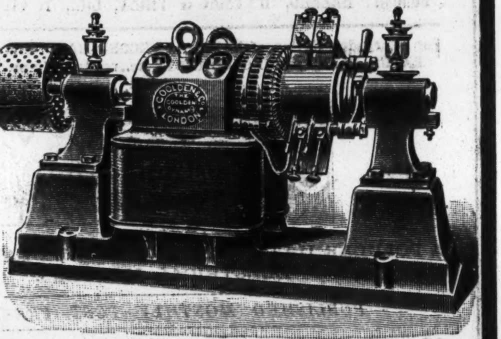


GOOLDEN & Co.,
Contractors to English & Foreign Governments,
Railways, Central Stations, &c.

DYNAMOS. Splendid Mechanical Construction.
Armatures insulated entirely with **MICA**
Armatures and Field Coils
VENTILATED INSIDE.
Long Bearings. Clean and Economical Lubrication.
CHEAPER than any Dynamos
working with same **MARGINAL FACTORS**
and at same **LOW TEMPERATURE.**

POSITIVE DRIVING
of Conductors.

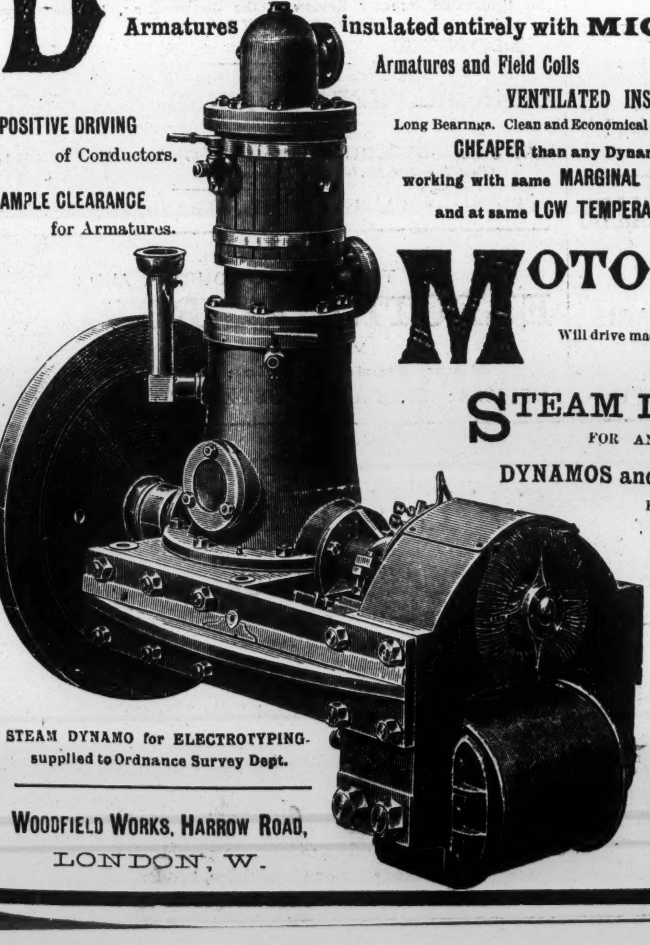
AMPLE CLEARANCE
for Armatures.



Standard Goolden Overtype Dynamo, built with Gramme, Drum and Bar Armatures.
HAVE BEEN BUILT IN ALL SIZES,
Some weighing over SEVEN TONS without Engine.
Dynamos of this type have worked at 350 volts, transmitting power in Mines (a severer test than lighting) for some years without a penny being spent in repairs.

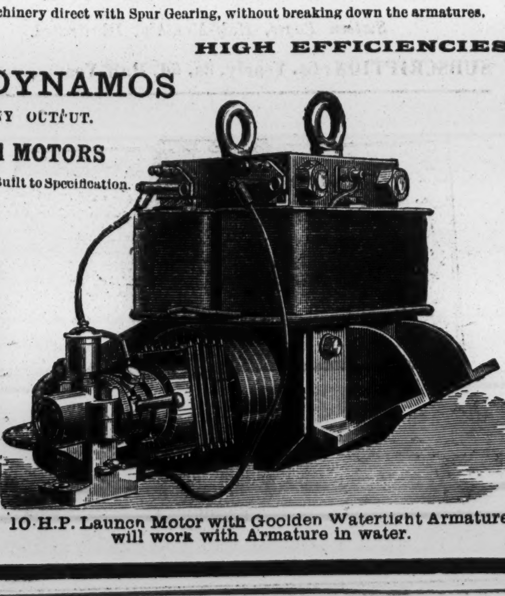
MOTORS
STRONGLY BUILT.
Will drive machinery direct with Spur Gearing, without breaking down the armatures.
HIGH EFFICIENCIES.

STEAM DYNAMOS
FOR ANY OUTPUT.
DYNAMOS and MOTORS
Built to Specification.



STEAM DYNAMO for ELECTROTYPING supplied to Ordnance Survey Dept.

WOODFIELD WORKS, HARROW ROAD,
LONDON, W.



10 H.P. Launch Motor with Goolden Watertight Armature; will work with Armature in water.

Publications.

THE NINTH ANNUAL PUBLICATION OF

BERLY'S ELECTRICAL DIRECTORY,

Fully Revised and Thoroughly Reliable. Bound Scarlet Cloth, Gilt Lettered, 514 Pages.

CONTAINS A LARGER AMOUNT OF COMMERCIAL TRADE MATTER THAN ANY OTHER ELECTRICAL DIRECTORY.

SECTIONS:—BRITISH, 338 Pages, Red Edges; AMERICAN, 82 Pages, Blue Edges; CONTINENTAL, 94 Pages, Yellow Edges.

THE LEADING ELECTRICAL TRADES DIRECTORY OF GREAT BRITAIN,

AND THE OLDEST ELECTRICAL DIRECTORY IN THE WORLD.

Post Free 6s.

Invaluable to Manufacturing Electricians, Electrical Engineers and Contractors, Telegraph and Telephone Constructors, Makers of High Speed and other Engines, Motors of all kinds, Driving Bands, Carbons, Chemicals, Insulators and Insulating Materials, Wire and Cable Manufacturers, Wholesale and Retail Dealers in Electrical Goods, and to Manufacturers of any article required and used by the Electrical Trades. No office is complete without a copy.

☞ CAN BE OBTAINED THROUGH ANY BOOKSELLER, OR FROM ☜

Wm. DAWSON & SONS, 148-149, Upper Thames Street, LONDON, E.C.

JUST PUBLISHED. Edited by CHARLES W. HASTINGS.

THE GAS, WATER AND ELECTRIC LIGHTING COMPANIES' DIRECTORY, 1890.

FOURTEENTH ANNUAL ISSUE.

Demy 8vo. 290 pp.; Cloth Boards, 5s. Post Free, Stiff Covers, 4s.

GASWORKS STATISTICS, 1890.

TWELFTH ANNUAL ISSUE.

Demy 8vo, Stiff Covers, 100 pp., 3s. 6d. Post Free.

WATERWORKS STATISTICS, 1890.

TENTH ANNUAL ISSUE.

Demy 8vo, Stiff Covers, 40 pp., 2s. 6d. Post Free.

THE ABOVE THREE WORKS HANDSOMELY BOUND IN CLOTH IN ONE VOLUME.

Price 10s. Post Free.

These books have been thoroughly revised to date, and contain much valuable and additional information.

London: HAZELL, WATSON & VINEY, Ltd., 1, Creed Lane. 3887

For every description of NEW and SECOND-HAND ELECTRICAL APPARATUS, PLANT and INSTRUMENTS, &c., ready for immediate delivery, Consult

Electrical Plant

A POPULAR ILLUSTRATED JOURNAL DEALING WITH ELECTRICAL MATTERS.

PUBLISHED MONTHLY—POST FREE, 6d.

Offices & Warehouse: 52, Queen Victoria St., & 39, Queen St., London, E.C.

Telegrams—"INDICES," LONDON. Telephone—1533.

Le MONITEUR des INVENTIONS INDUSTRIELLES

15th YEAR.

6 BOULEVARD DE STRASBOURG PARIS.

Sixteen Pages, Half-Monthly, Illustrated.

SUBSCRIPTION: 6s. Yearly, 3s. 6d. Half-Yearly, Post Free.

LE GENIE CIVIL,

Weekly Review of French and Foreign Industries in General,

6, RUE DE LA CHAUSÉE D'ANTIN, PARIS.

Editor-in-Chief, MAX DE NANSOUTY, Ingenieur des Arts et Manufactures, Officier d'Academie, Secretary of the Electrical Committee of the Exhibition of 1889.

LE GENIE CIVIL deals with all subjects connected with Science and Industry, Arts, Architecture, Construction, Hygiene, Public Works, Electricity, Chemistry, Railways, Mechanics, &c.

THE BEST CONTINENTAL ADVERTISING MEDIUM OF ALL.

All communications for the Advertising or Publishing Department to be addressed to Mr. BOCQUET, GENIE CIVIL OFFICE, 6, Rue de la Chausée d'Antin, Paris. 102

ESTABLISHED 1880.

THE

Railway Engineer

An Illustrated Monthly Review of the Construction, Machinery and Administration of Railways.

MONTHLY, ONE SHILLING.

A Valuable Work for Reference, illustrated with large

LITHOGRAPHED WORKING DRAWINGS

Of Locomotives and other Rolling Stock; Bridges and all kinds of Railway Appliances.

ANNUAL SUBSCRIPTIONS, IN POSTAL UNION, 14s.

(Payable in Advance, including Postage.) Specimen Copy Post Free, 1s.

OFFICES:—8, CATHERINE ST., STRAND, LONDON, W.C.

ESTABLISHED 1872.

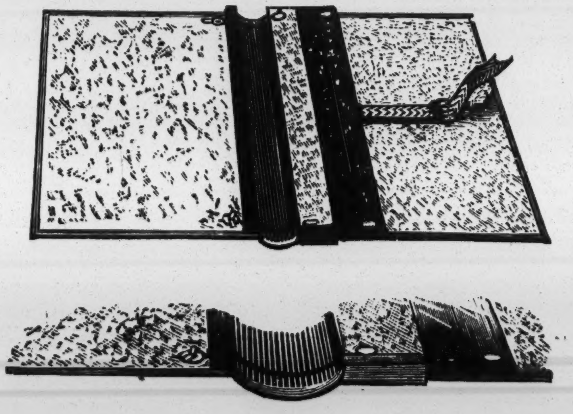
THE TELEGRAPHIC JOURNAL AND

ELECTRICAL REVIEW

VOL. 26

Now Ready.—Price 12s., Cloth.

OFFICES: 22, PATERNOSTER ROW, LONDON.



PATENT

SELF-BINDERS

FOR

THE "ELECTRICAL REVIEW."

THIS Self-Binder, or Reading Case, is intended to hold ELECTRICAL REVIEWS of any number until the half-yearly volume is completed and ready for permanent binding, the width of the back being widened or contracted by sliding the back cover in or out as desired.

To be obtained at the ELECTRICAL REVIEW office, 22, Pater noster Row, London.

Price 6s., Post Free (in Great Britain) 6s. 6d.

Cheques and Money Orders to be made payable to H. ALABASTER the latter on Chief Office, London.

Cloth, 4s. 6d., Post Free. 55 Illustrations. By JAMES SWINBURNE.

Practical Electrical Measurement.

"Altogether the book is an excellent one, the few points that have been objected to in this notice being almost the only ones that out of a large mass of matter have struck us as perhaps open to criticism."—*Electrician*, February 15th, 1889.

"The author comes to his task, however, so well equipped by practical experience, that there appears to be a basis for his very pronounced confidence. His selection and treatment of the subject matter is decidedly original, and a large amount of stereotyped matter, which is usually deemed indispensable to works on electrical subjects, is conspicuous by its absence."—*The Electrical Engineer*, (New York), February, 1889.

"Taken as a whole, the book is a most readable and instructive one, and, with the illustrations, is a valuable addition to the literature of a subject which is interesting to all engaged in practical electrical work."—*Electrical World*, New York, January 12th, 1889.

"It does not need commending; we have only to give the author's name and that of the publishers."—*Electrical Plant*, January, 1889

Leather, 5s., Post Free. By H. R. KEMPE, M.Inst.E.E., A.M.Inst.C E.

The Electrical Engineer's Pocketbook

OF MODERN RULES, FORMULÆ, TABLES AND DATA.

Cloth, 5s., Post Free, Crown 8vo. By JOHN W. URQUHART, Electrician,

Electric Light Fitting:

A HANDBOOK FOR WORKING ELECTRICAL ENGINEERS, EMBODYING PRACTICAL NOTES ON INSTALLATION MANAGEMENT.

Cloth, 4s. 6d., Post Free. 41 Illustrations and 5 Tables. By F. B. BADT.

Incandescent Wiring Handbook.

Multiple Arc System; Three-Wire System; Methods of Running Wire; Location of Safety Devices and Switches; Fixtures and Elevators; Wire Gauges; General Electrical Data; Calculating Sizes of Wires; and two Appendices.

Cloth, 4s. 6d., Post Free. 70 Illustrations. By F. B. BADT.

Dynamo Tenders' Handbook.

Elementary Data; Arrangement of Power; Dynamo-Electric Machines; Diseases of Dynamos; Lamps; Instruments; Circuits or Leads; Accumulators; Safety Regulations; Table of Electric Light Conductors; Lamp Lighting Schedule; Construction Tools.

Cloth, 4s. 6d., Post Free. 97 Illustrations. By F. B. BADT.

Bell Hangers' Handbook.

Voltaic Electricity; Description of Batteries; Elementary Data; Connecting Batteries; Battery Data; Electro-Magnets Induction Coils; Electric Bells; Annunciators; Electric Alarms; Gas Lighting Apparatus; Electric Heat Regulation; Running Electric Wires; Testing Instruments.

Paper Covers, 1s. Post Free. By EDWARD TREVERT.

Everybody's Handbook of Electricity.

WITH GLOSSARY OF ELECTRICAL TERMS AND TABLES OF INCANDESCENT WIRING.

Cloth, 3s. 6d., Post Free. Illustrated. (Translation.) By Dr. TUMLIRZ.

Electric Potential.

Cloth, 12s. 6d., Post Free. By G. S. BOWER and W. WEBB.

Law of Electric Lighting.

Cloth, 12s. 6d., Post Free. Illustrated. (2nd Edition, Enlarged.)
By T. C. MARTIN and J. WETZLER.

The Electric Motor and its Applications.

Elementary Considerations; Early Motors and Experiments in Europe; Early Motors and Experiments in America; Electrical Transmission of Power; The Modern Electric Railway and Tramway in Europe; The Modern Electric Railway and Street Car Line in America; The Use of Storage Batteries with Electric Motors for Street Railways; The Industrial Application of Electric Motors in Europe; Ditto in America; Electric Motors in Marine and Aerial Navigation; Telpherage; Latest American Motors and Motor Systems; Latest European Motors and Motor Systems; Alternating Current Motors; Thermo-Magnetic Motors.

Published by H. ALABASTER, GATEHOUSE & CO.,
22, PATERNOSTER ROW, LONDON.

EWEN & Co.'S STEAM BOILERS
LOCO, MULTITUBULAR,
LANCASHIRE and other types,
Constructed for High-Pressure Steaming.
FITTED WITH APPARATUS ELIMINATING ALL DEPOSIT ON BOILER PLATES. GUARANTEED.
ENGINEERS & BOILER MAKERS,
WALBROOK HOUSE, LONDON, E.C.
Works: St. GEORGE STREET, LONDON, E.
ILLUSTRATED PRICE LIST UPON APPLICATION. 3834
London Office of CHARLESWORTH, HALL & CO., *See Advertisement Page Sup.* 19.

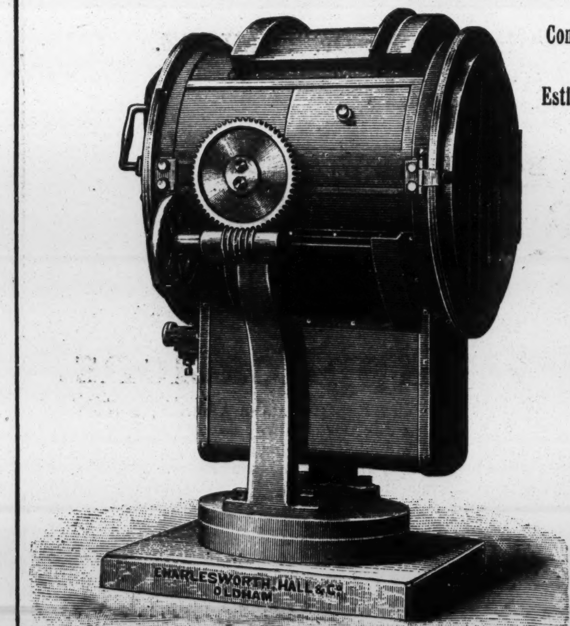
INCANDESCENT ✦ LAMPS
EVERY NECESSARY FOR ELECTRIC LIGHTING.
DYNAMOS OF THE BEST CONSTRUCTION.
MEASURING INSTRUMENTS AT LOWEST PRICES. 3811
F. ZÖPKE, Wilhelm-Strasse, 98, BERLIN, W.

USE THE "GROSVENOR" PATENT CEILING CONNECTOR.
USE F. L. & CO.'S PATENT LAMP CAPS.
ALL ELECTRIC LIGHTING AND TELEGRAPHIC SUPPLIES.
Send for Samples and Quotations.
☞ Note:—
2062
FOWLER, LANCASTER & Co., Ltd., Birmingham.

CHARLESWORTH, HALL & Co.,
Electrical Engineers,
RICHMOND HILL IRON WORKS,
Telegrams: "CHARLESWORTH, ENGINEERS,"
OLDHAM.
SILVER MEDAL, BARCELONA, 1888.
MAKERS OF
HIGH-SPEED ENGINES,
DYNAMOS & MOTORS,
SEARCH-LIGHT PROJECTORS, &c.
SHIP LIGHTING A SPECIALITY.

LONDON AGENTS,
EWEN & Co.,
37, WALBROOK, E.C.

Complete Installations of all kinds.
Estimates on Application.



The following sizes of Compound-Wound Dynamos are kept in stock or in progress.

Lamps.	Amps.	Volts.	Speed.	PRICE.
90	45	100	852	£76
180	90	100	1020	£99
220	120	100	880	£121
400	200	100	825	£170

PROJECTORS IN STOCK.
3522

POOLE & WHITE,

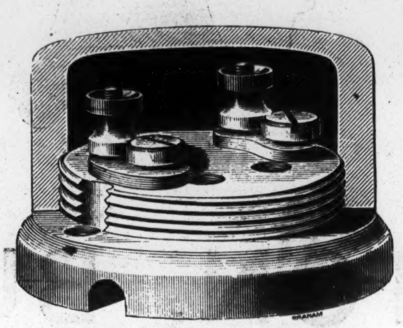
LIMITED,

WORKS, SHOWROOMS AND OFFICES:

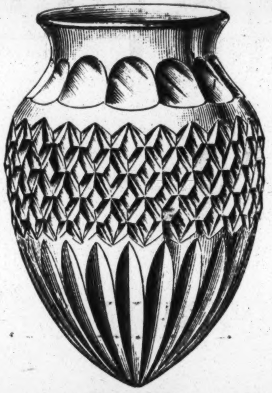
58 & 59, BREAD ST., CHEAPSIDE, LONDON, E.C.

TELEGRAPHIC ADDRESS:
"PLATESSA, LONDON."

TELEPHONE No. 1982.

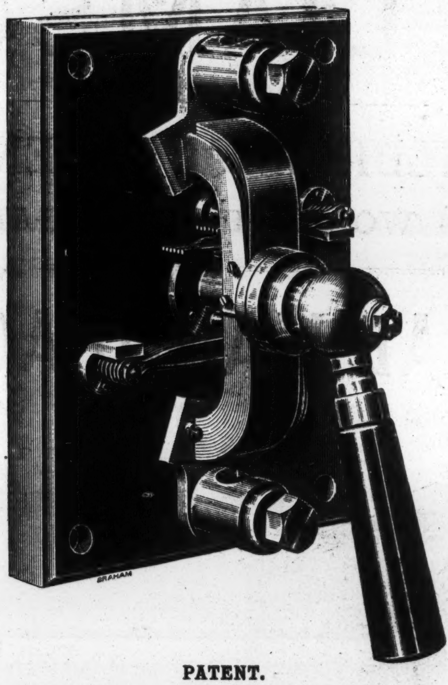


20 AMP. PORCELAIN CUT-OUT.



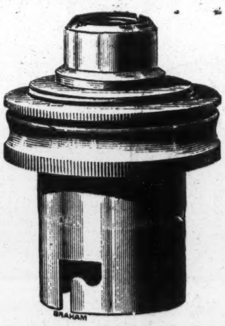
No. 15,241.

WHITE'S 200 AMP. QUICK BREAK SWITCH.

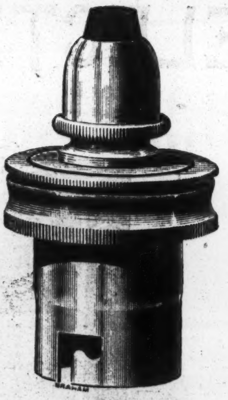


PATENT.

No. 3,296.

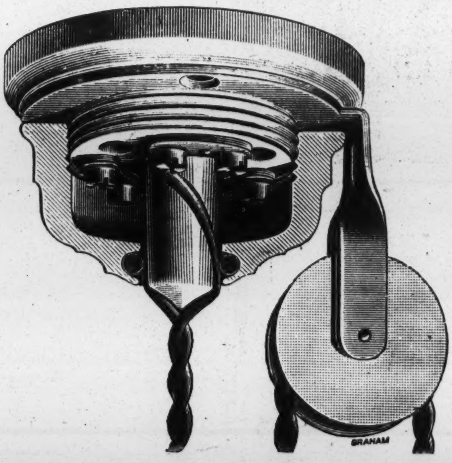


No. 3 HOLDER.



No. 4 HOLDER.

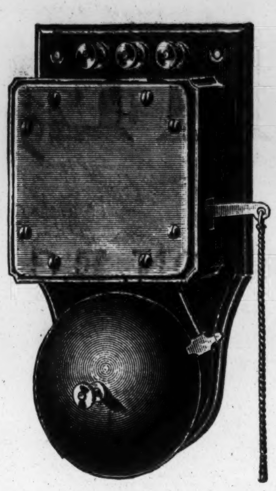
No. 3,271.



WHITE'S PATENT CEILING ROSE AND PULLEY.

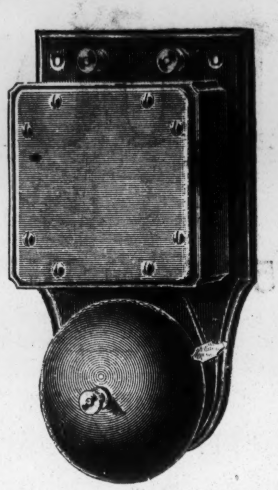
No. 706.

PRICES AND FULL PARTICULARS ON APPLICATION.



BELLS OF EVERY

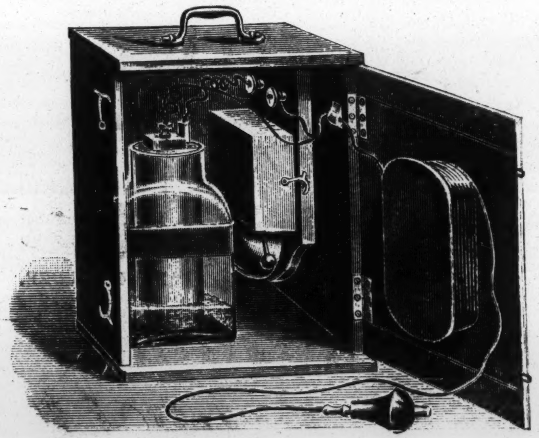
DESCRIPTION

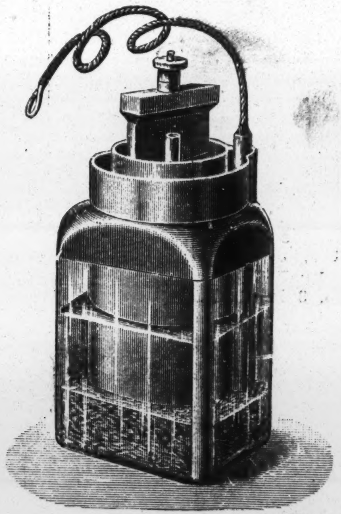


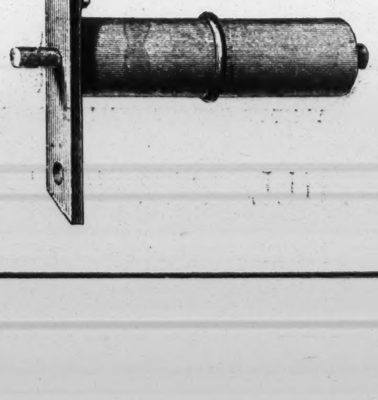
APPLETON, BURBEY
AND
WILLIAMSON.

BALMORAL BUILDINGS, 91, QUEEN VICTORIA ST.
STEAM WORKS, HATTON GARDEN.

ELECTRICAL MANUFACTURERS.







WILLANS CENTRAL VALVE ENGINES

(PATENTS OF 1884 AND 1885),

Are made in Ten Standard Sizes, from **3** to **530 I.H.P.**, with either One or Two Cranks, and for Speeds of from **280** to **700** Revolutions.

They are equally suited for **Condensing** or **Non-Condensing**; for the direct driving of **High-Speed Machines**, such as **Dynamos** and **Fans**, or for **Driving General Machinery** by Belts or Gearing. It is now fully established that they possess **Extraordinary Freedom from Wear**, as **all** Bearings are in "constant thrust" (which is not the case with many Single-Acting Engines), and are Self-Lubricated. Their **Small Size and Weight**, while advantageous in all cases, fit them for uses to which the majority of engines are inapplicable. Al except the smallest sizes are made either **Simple**, **Compound**, or **Triple-Expansion**, according to the pressure available, and recent trials show that they work with a

SMALLER CONSUMPTION OF STEAM

Than **any** other type of engine in the market indicating equal power. Non-Condensing, a consumption of steam as low as 18·2 lbs. per I.H.P. per hour has been recorded, and the Makers are prepared to **Guarantee** that the larger Condensing Engines shall work, at least, as economically as the best class of Compound Corliss Engines, while possessing enormous advantages in **Lightness**, **Compactness** and **Cheapness**.

THE WILLANS CENTRAL-VALVE ENGINE IS WITHOUT RIVAL

FOR ELECTRIC LIGHTING,

For which purpose several hundreds have already been applied with the utmost success. Engines are on order at the present time for nearly all the most important Public Lighting Stations now under construction in England, and the indicated power of the Engines already supplied, or now on order, exceeds

Thirty-Thousand Horse-Power.

PRICE LISTS WITH FULL PARTICULARS ON APPLICATION.

WILLANS & ROBINSON, LTD., ENGINEERS,

THAMES DITTON, SURREY. 3015

THE NEWTON ELECTRICAL ENGINEERING WORKS, TAUNTON.

THE

"TAUNTON" DYNAMOS

AND

MOTORS.

Highest Efficiency; Beauty of Design; Moderate Speeds; Best Workmanship and Materials.

NEWTON & HAWKINS'

PATENT

AUTOMATIC SWITCHES.

NEWTON **ARC** LAMPS.

And every Requisite for Electric Lighting and Transmission of Power. 3903

Telegrams: "ARC," TAUNTON.

WESTERN ELECTRIC CO.

TELEPHONIC APPARATUS.

ARC LAMPS AND DYNAMOS.

PATTERSON CABLES FOR TELEPHONES, TELEGRAPHS AND ELECTRIC LIGHT.

79, COLEMAN STREET, LONDON, E.C.

CHICAGO, NEW YORK AND ANTWERP.

1906

CENTRAL STATIONS.

CROMPTON & COMPANY, LIMITED, have erected, or are now erecting, Central Stations, and manufacturing machinery for same, to supply

321,000 LAMPS.

This represents two-thirds of the total horse-power being put down in this Country for Continuous Electric Supply, or in other words,

100,000 LAMPS

MORE THAN ALL OTHER LOW PRESSURE SYSTEMS COMBINED.

Full information on the latest developments of Electrical Engineering and Tenders for Central Stations of any magnitude, can be obtained by applying to—

CROMPTON & CO., Ltd.,

MANSION HOUSE BUILDINGS, LONDON, E.C.

Works:—CHELMSFORD & LONDON.

311

THE

WESTINGHOUSE ELECTRIC Co.,

LIMITED,

4, VICTORIA MANSIONS, 32, VICTORIA STREET, S.W.

MANUFACTURERS OF

ELECTRIC LIGHTING APPARATUS

FOR

CENTRAL STATIONS & ISOLATED PLANTS.

ESTIMATES ON APPLICATION.

3265